CONNECTING ALASKANS: MIXED-USE SAFETY AND ACCESSIBILITY CHALLENGES IN RURAL ENVIRONMENTS

By

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ABSTRACT

Connectivity in transportation networks, or lack thereof, is a challenge that many people have to deal with. Alaska has many rural communities that are inaccessible by conventional modes of transportation. In order for people to reach these communities and move between them unconventional modes of transportation are needed. However, very few studies have been done on unconventional transportation modes such as ATVs and snowmachines and the level to which they contribute to connecting people and how to help limit traumatic injuries of users. This study focuses on Alaska and three primary datasets. First, the Pacific North West Transportation Survey developed by the University of Alaska Fairbanks and the University of Idaho. Second, Alaska Trauma Registry data obtained from Division of Public Health and Safety. Thirdly, publicly available GIS transportation network and populated place data. These three data sets accomplish the following objectives: (1) document preferences and perceptions of mixed-use safety, (2) to better understand the reasons for injuries and fatalities involving ATVs and snowmachines, and (3) to identify potential mixed-use conflict areas by geographic mapping of traumas. From this analysis a better understanding of ATV mode use was discovered. ATVs are used for a variety of trip purposes including: commuting, running errands, chores, and recreation. ATVs are used on and near roadways 24% of the time. There are twice as many ATV-related traumas in connected places than in isolated places, and 3 times more ATV related traumas in highway connected places than secondary road connected places. Snowmachines are used on and near roadways 23% of the time and have 3 times as many traumas in highway connected places than secondary road connected places. Highway connected places have a significantly higher risk of having ATV and snowmachine traumas than road connected places. This indicates that part of the issue could be the amount of traffic in connected areas, or perhaps the frequency of use of ATVs rather than automobiles in non-connected areas leading to fewer mixed-use scenarios.

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1 INTRODUCTION

con·nec·tiv·i·ty (n.)
/ kon-ek-tiv-i-tee, kuh-nek- /

The state or extent of being connected or interconnected (Oxford Dictionaries, 2017).

1.1 Motivation

Approximately 44% of the residents of Alaska live in areas classified as rural which is over twice the percentage for the entire United States (U.S). Though the average population of all 355 Census designated places in Alaska is only 3,322 (US Census Bureau, 2010), if you were to exclude the three largest populated cities of Anchorage (291,826), Fairbanks (31,515), and Juneau (31,275), the average population dwindles to only 945. This presents signifcant transportation mobility challenges. Across Alaska there are also a total of 229 federally recognized tribes and Alaska Native regional corporations that inhabit many of these rural areas (National Congress of American Indians, 2015).

While many rural areas in the contiguous U.S. are connected by roads, in Alaska 70% of the land area is inaccessible by road (Alaska Federal Health Care Partnership, 2010) as seen in Figure 1. Larger in land mass than any other state in the nation, over twice the size of Texas (Figure 2), Alaska has the lowest population density at only 1.2 people per square mile and the fewest relative lane miles at 0.05 miles per square mile (USDOT, 2016, Shreckengast, 2016). The inaccessibility of many areas of the state is in part due to the varied and unique terrain such as 14 mountain ranges, tundra/permafrost, glaciers, and rivers. In order to navigate Alaska's diverse and rugged yet delicate terrains, networks such as trails connect communities that would otherwise be reachable only by air or water. Consequently, transportation modes such as all-terrain vehicles (ATVs) and snowmachines serve as primary modes of transportation within and between these rural communities. Even Alaska residents in urban areas own ATVs and snowmachines for both utilitarian and recreational purposes and use them as both primary and secondary modes of transportation. From 1999 to 2014 a total of 10,046 ATV deaths have occurred in the United States (Topping, 2015). During the years of 1985 through 2009 62% of ATV deaths occurred on roads (Denning, Harland, Ellis, & Jennissen, 2012). There have even been years in Alaska where snowmachine related deaths were greater than automobile related deaths (Pierz, 2003). These safety challenges have not yet been comprehensively addressed and are a large component of the research presented in this study.

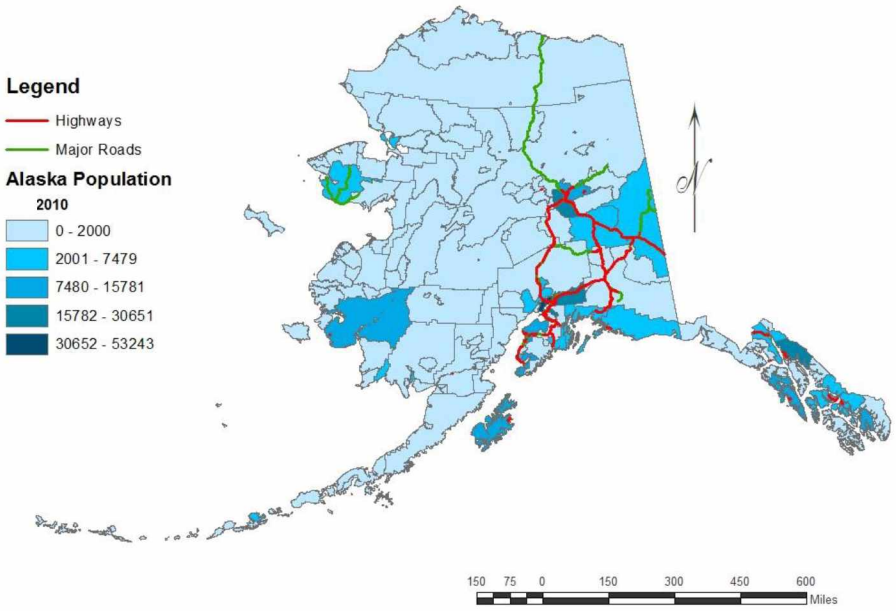


Figure 1. The major highway and road systems in Alaska shown with population data by zip code

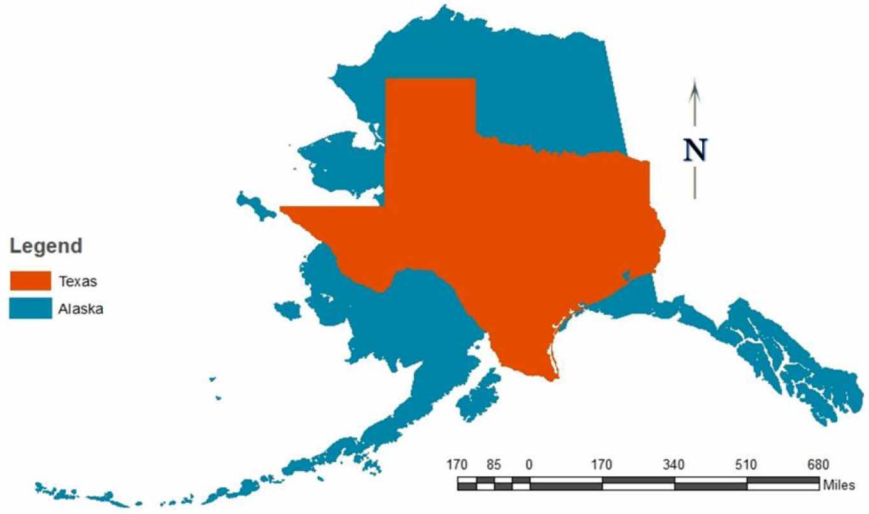


Figure 2. Comparative size of Texas to Alaska

Because of its rurality, Alaskans rely on unconventional modes of transportation. Mushing and ATVs are often the only travel options and provide efficient transportation for many families in remote and isolated locales. The use of unconventional transportation modes is necessitated by several factors including vehicle availability, fuel cost and efficiency, transport cost, and convenience. Unconventional transportation modes can be used for both recreation and utilitarian

purposes and therefore are more appealing to many rural residents where access to goods and services may only require short distances by gravel road, boardwalk, or trail.

Alaskans rely on a wide variety of transportation infrastructure including roads, highways, trails, and perhaps more so than any other state, airports and rivers. As an example, there are 410 active commercial and public use airports in the state with an additional 29 military air fields as well as countless private airstrips. As such, Alaskans utilize a wide variety of transportation modes to move around the state such as airplanes, boats, automobiles, ATVs, snowmachines, and bicycles. This paper focuses primarily on terrestrial travel via roads and trails and the modes used in that travel. Based on a prior knowledge of mode use in the state, Figure 3 depicts the classification structure of the transportation modes discussed in this paper. This hierarchy classifies each mode into conventional motorized, conventional non-motorized, unconventional motorized, and unconventional non-motorized categories.

It is important to understand how non-motorized and unconventional users behave in mixed-use scenarios. It is also important to understand their interactions with conventional mode types in order to provide safe conditions for all modes and users.

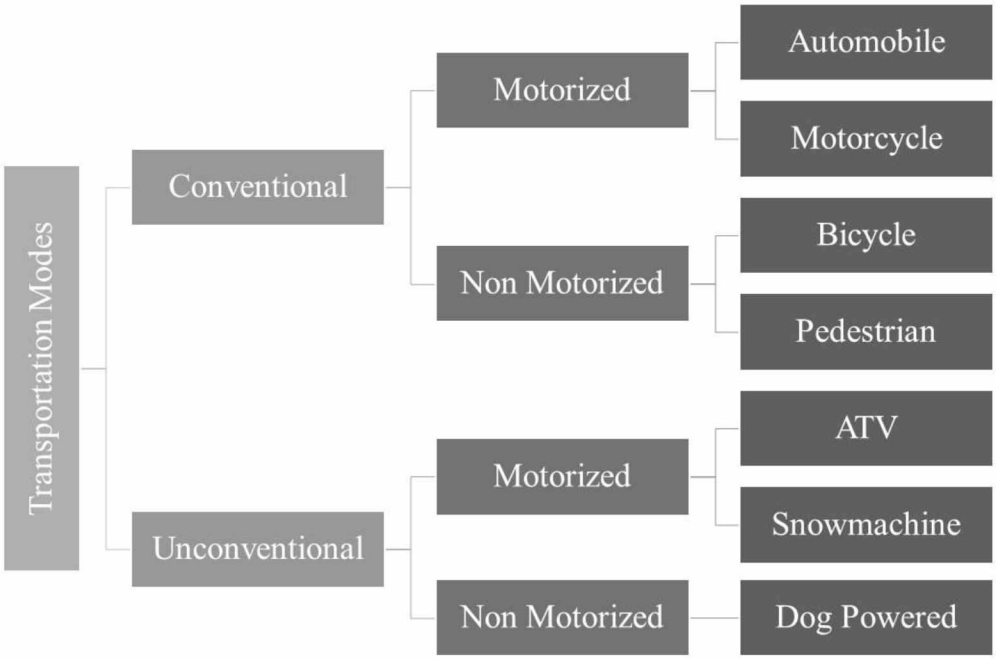


Figure 3. Transportation mode hierarchy and classification

The limited data available for unconventional mode use and travel make it difficult to develop and maintain safe infrastructure and policies. The lack of availability is exacerbated by non-reporting of crashes and a limited number of studies and surveys, especially in Alaska and especially for unconventional-type modes. Determining the scale and contributors to potential safety issues is important when informing design and policy to ensure all modes of transportation can be accommodated in an economical, safe, and equitable manner.

The primary motivation for this research was to enhance our understanding of transportation safety and accessibility challenges in Alaska as they relate specifically to less conventional modes of travel. The findings of this research have implications for both policy and design of rural transportation systems.

1.2 Objectives

Currently there is a lack of data regarding unconventional transportation mode use to adequately address safety needs. Further, transportation engineers and planners could benefit from better understanding on how to connect Alaskans by understanding the primary modes of transportation being used across the state. The goal of this research was to better understand how and why unconventional modes of transportation (e.g. ATVs, snowmachines, and dogsleds) are being used and what measures could be taken to improve the safety of these transportation system users. This goal was reached by achieving three primary objectives. First, a transportation survey on unconventional transportation mode use and mixed-use safety perspectives was developed, distributed, and analyzed. This survey focused on obtaining real world feedback regarding transportation mode use on and near roadways and obtaining perceived and self-reported safety concerns. Second, the Alaska Trauma Registry data (publicly available hospital records from the Division of Public Health and Safety) was organized and analyzed to complement conventional Department of Motor Vehicle (DMV) crash records to identify unconventional and non-motorized transportation mode traumas and locations. Third, state wide connectivity was defined in terms of transportation network presence and populated places using publicly available GIS data.

Together, these three elements constitute a novel approach was able to:

1. Document stated preference and perceptions of rural mixed-use safety.
2. Provide better quantification of injuries and fatalities involving Alaska's unconventional modes of transportation.
3. Identify potential mixed-use conflict areas/locations based on geographic mapping of traumas.

1.3 Organizational Overview

First, Section 2 provides a literature review of the different modes of transportation primarily used in Alaska and the need to study safety related to these modes. In Section 2.1 mobility challenges of Native and rural Alaskan culture are discussed. Section 2.2 presents motivations for unconventional transportation mode use. Section 2.3 defines mixed-use contexts with consideration of unconventional transportation modes. Section 2.4 presents safety issues related to both non-motorized and unconventional transportation modes. Section 2.5 illustrates the availability of data for transportation modes in Alaska. Existing policies related to transportation modes and where they are allowed to operate are discussed in section 2.6. Section 2.7 provides information on current design practices used by the Department of Transportation and Public

Facilities (DOT&PF) and other agencies. Lastly, Section 2.8 presents conclusions and discusses the necessity of this research.

The Methods section (Section 3) and the Results section (Section 4) outline the various methods for analyzing and interpreting the data in this report. First, the Pacific Northwest Transportation Survey, an observational study of the different modes of transportation that people in Alaska use on and near roadways, how safe they feel using those modes, and what safety issues they have encountered is discussed in Sections 3.1 and 4.1. Second, the Alaska Trauma Registry (Section 3.2 and 4.2) is collected and managed by the Alaska Department of Health and Social Services Division of Public Health. Though the registry required significant scrubbing and filtering, it provides a robust record of injuries across the state of Alaska, including those involving modes of transportation and also indicates where these incidences occurred. The data used in this analysis spanned the years of 2004 and 2011. Thirdly, GIS trails and road network data and satellite imagery (Section 3.3 and 4.3) were primarily procured from the Alaska State Geospatial Data Clearinghouse. These data were used to determine which populated places in Alaska are connected, how they are connected (i.e., by highway, secondary road, or trail), and which places are isolated (not connected to other places by highways, secondary roads, or trails). A bridged analysis of the trauma and GIS data (Section 3.4 and 4.4) analyzes the location of traumas and the types of transportation modes used when the trauma occurred. Lastly, Section 5 provides and overall discussion of results and conclusions which includes recommendations for future research.

2 LITERATURE REVIEW

The United States Census Bureau defines areas based on population density. If an area has sufficient population density, it is classified as urban. The current density requirements for urbanized areas and urban clusters are 50,000 or more and 2,500 – 50,000, respectively. All areas not classified as urban are classified as rural (U.S. Census Bureau, 2015). In the United States 64 million people, (roughly 20% of the total population) live in counties classified as rural. In contrast, Alaska's rural population accounts for 34% of the state population. Native Alaskan lands comprise about 43% of the State of Alaska. Most, if not all, of these are classified as rural. Further, the topography of Alaska is such that many communities are isolated either by physical features (e.g., mountains, ocean, or rivers) or by natural settlement patterns. These areas include towns such as Yakutat (Figure 4a) and Cordova City (Figure 4b) that have small road systems which exclusively serve those communities, but offer no connection to other nearby small towns like Katalla and Tatitlek, or major cities like Anchorage and Juneau. In addition, and previously known only anecdotally, unconventional modes of travel (e.g., ATVs and snowmachines) are often used as primary or secondary methods of travel in these areas despite existence of road infrastructure. Other villages, such as Newtok (Figure 4c), have no roads. Instead boardwalks (i.e., raised platforms constructed of wood), rivers, and trails are used to travel in and around the community. Rivers are traversed by boat during summer months and snowmachine during winter months.

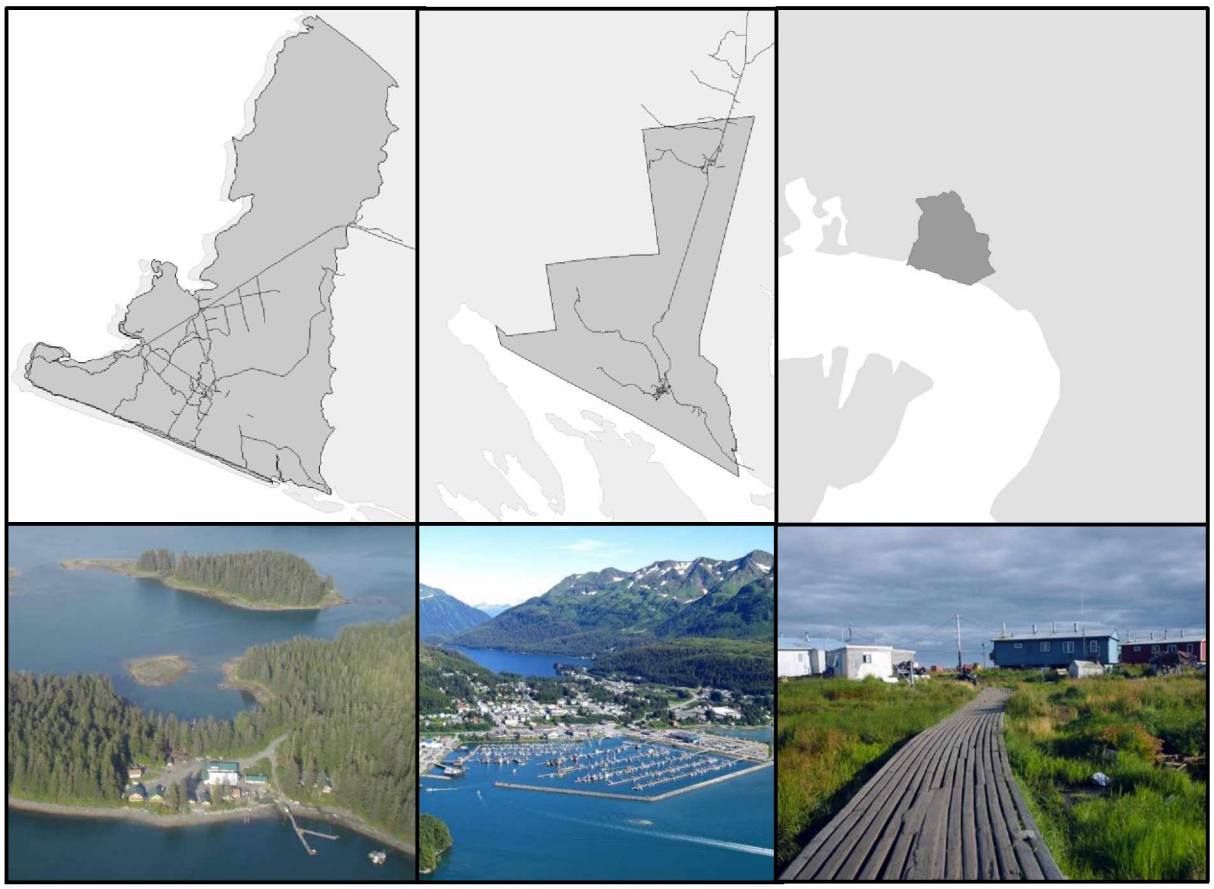


Figure 4. Example network data and aerial imagery for (a) Yakutat, (b) Cordova City, and (c) Newtok

Moreover, many Alaskans that live in areas without roads seek to preserve and maintain subsistence lifestyles. A subsistence lifestyle is considered one in which people harvest plants and meat from the land for survival. Approximately 37 million pounds of wild foods including caribou, moose, berries, and other plants are harvested by subsistence users each year in Alaska (Alaska Department of Fish and Game, 2017).

Transportation is a critically important part of a subsistence life style as it requires significant amounts of traveling to hunting and fishing areas, as well as visit neighboring villages for cultural and tribal events. Many areas of Alaska are difficult to traverse either because of muskeg (swamp-type land consisting of a mixture of water and partly dead vegetation) and tundra (delicate ecosystem of mossy plants that cover permanently frozen ground) in the summers and then large snow drifts in the winter. Without state maintained routes, people in these areas rely on unconventional modes of transportation in order to collect plants, hunt, and visit family and friends. Travel within communities can also be difficult when only trails and narrow boardwalks are present. These unique networks create mixed-use scenarios and potential safety challenges that have not been well-studied or addressed.

Referring to the previously defined unconventional mode categories (See Section 1.2), "unconventional" refers to modes that are not typically considered in the planning and design of transportation infrastructure. For a detailed schematic of how the modes are categorized refer to Figure 3 for the mode hierarchy. These modes range from more modern and motorized vehicles types that are intended for more off-highway use (e.g., all-terrain vehicles, side-by-sides, snow machines, and dirt bikes) to modified uses of existing non-motorized modes (bikejoring, skijoring, etc.) to more culturally relevant modes (dogsleds, horses, etc.) that existed well before automobiles. The experience in Alaska is that these modes have either been: 1) completely displaced by roads primarily serving other transportation modes; or 2) limited in their mobility by roads and regulations focused on automobiles, bicycles, and pedestrians. As a result, significant safety issues have arisen from a lack of designated trails or road crossings and limited regulation and sporadic enforcement (for more discussion see Section 2.4). As outlined in the Alaska DOT and Public Facilities Strategic Highway Safety Plan (AK DOT, 2017), unconventional modes of particular concern include ATVs, and snowmachines. Trauma and injuries associated with the operation of those modes on public road facilities warrants consideration. Additionally, there are over 30 clubs and organizations in Alaska that take part in activities using these unconventional modes.

2.1 Mixed-Use Context

Many trails, paths, or roadways are designed for a specific mode or modes of transportation (e.g., typically automobiles, bicyclists, and pedestrians). Additionally, any travel way not specifically designated for a particular mode then becomes mixed-use by omission of regulation. Some of these modes (as previously discussed) include dogsleds, snowmachines, and ATVs. In addition to use on trails, ATVs and other "off-highway" modes are used on roadways, and thereby causing some roads to become incredibly mixed-use as well. This use can exist in the form of outright travel of the roadways (Figure 5), or crossing a road where a trail intersects the roadway (Figure 6). Often these trails and roads are in remote areas and lack adequate signage to indicate user right-of-way or other safety advisories such as speed limits. However, in more urban and maintained areas some signs (Figure 7) that indicate right-of-way and trail sharing can be found. This is not to say that all trails or road crossings are adequately marked in urban areas and enforcement of etiquette is up to community members rather than trail officials.

Figure 5. A person operating an ATV on the roadway in Chitina, AK

Figure 6. Trail intersecting with a roadway near Paxson off of the Richardson Highway (AK Route 4)

(a) (b)

Figure 7. Multi use and right of way signs used for mixed-use trails in Alaska at (a) Ekultna Lake in Chugiak and (b) Creamer's Field in Fairbanks

2.2 Motivations for Unconventional Mode Use

There are three primary reasons why people use unconventional modes of transportation: economy, efficiency, and lifestyle.

In terms of economy, the more cost effective a mode is the more desirable it is. In rural areas of Alaska, gasoline and diesel fuel are expensive at an average of $7 per gallon (in 2015) and can reach as high as $10 per gallon. Comparatively, prices in the contiguous United States are about $2.30/ gallon in 2015. (Grove, 2015, Demer, 2015). Due to these high fuel costs Alaskans are reducing the number of trips they take even for subsistence activities. From 2004 to 2014 travel distance for subsistence trips decreased by 60%, and the number of trips has decreased by 75% (Brinkman, et al., 2014).

Non-motorized and unconventional modes of transportation are more fuel efficient than conventional automobiles. This is tied to economy in terms of gas prices, but also necessary when traveling long distance without access to fuel along the way. This efficiency is vitally important not only due to the cost of fuel, but also the long distances that must be covered without access to a fuel station. Unconventional modes get, on average, 45 mpg which is about 2.5 times more fuel efficient than a conventional motor vehicle (ATV Connection, 2017). With a tank size of approximately 4.25 gallons, most ATVs can get close to 200 miles on a single tank of gas.

Unconventional modes of transportation are better at navigating the varied terrain found in the Alaskan wilderness. Unconventional modes are also quite multi-purpose in nature and can be used for anything from getting the mail or a jug of milk at the store to hauling a moose or caribou out of the backcountry. Many Alaskans use dogs and dogsledding as a way to accomplish tasks such as hauling wood, transportation, resource harvesting, racing, and trapping. These dogs eat

about 37% of the subsistence caught salmon in Alaskan communities (Andersen, 1992). Modes such as snow machines and ATVs are more closely related to traditional dog powered modes. They also offer the same kind of mobility over uneven and unmaintained terrain (Andersen, 1992). Even people who have lived in and around populated places like Fairbanks and Anchorage still enjoy trails to more remote areas for recreation and hunting. Alternative modes are often needed to reach remote destinations, track game for long distances, or even to haul meat if a hunting trip is successful.

Non-motorized unconventional modes of transportation consists of a large group including culturally relevant modes of transportation such as dogsleds (Figure 8a), as well as more modern hybrids such as skijoring and bikejoring (Figure 8b).

(a) (b)

Figure 8. Examples of unconventional non-motorized transportation showing (a) a musher and dog team, and (b) a person bikejoring with his dog in Denali National Park.

Skijoring was originally done behind a horse in Europe around 1920 and was even, briefly, a winter Olympic sport (McNichol, 2014). It evolved into a skier being pulled by a dog and became a popular competitive sport in Fairbanks Alaska in the mid-1980s (Hoe-Raitto & Kaynor, 2012). Since then other sports similar to bikejoring have evolved. Bikejoring involves a bicyclist being pulled by one or more dogs while riding a bicycle or sometimes a scooter. This and other sports are often done on or near roadways or on trails that intersect with roadways.

Another popular dog-powered sport is dog mushing. This involves a sled with the musher (a person commanding a team of dogs) riding on the back of the sled and a team of dogs wearing harnesses pulling the sled. Every year the Norwegian dog mushing school brings 15 -18 students to the Manly area in Alaska to embark on a 10-day, 200-mile, expedition to Iniakuk Wilderness lodge with local musher Brent Sass (Sass, 2017). Additionally, Alaska holds several well-known races including but not limited to the Yukon Quest, a 1,000 mile race between Fairbanks AK and Whitehorse Yukon, and the Iditarod, a 1,000 mile race between Anchorage AK and Nome AK. While the majority of the races take place in remote areas or on designated trails many of the check points for long races are in towns or villages. Additionally, professionals, amateurs, and recreational mushers alike all use trails and paths that often intersect roadways.

Dog teams are an integral part of the subsistence lifestyles in Alaska. They have been used since about the mid 1800's to aid in a myriad of activates such as hunting/trapping, transportation/exploration, commercial freight such as medicine, and family mobility (Andersen, 1992). One of the benefits of a dog team over motorized transportation is that they can eat the readily available salmon and game meat such as moose and caribou making them a more economical transportation option for many rural/subsistence people (Andersen, 1992).

In most areas of the United States, "unconventional" vehicles comprise such a minor portion of the traffic stream composition that they do not merit consideration as primary mode of transportation. However, in the State of Alaska (and quite possibly other international countries, particularly those in circumpolar regions) the use of these unconventional forms of transportation often surpasses those of more conventionally considered non-motorized forms of travel (i.e., bicyclists, pedestrians, and sometimes even automobiles). For example, there have been years when, historically, the number of fatalities on or near roadways associated with the use of snowmachines was higher than that of personal automobiles (Landen, Middaugh, & Dennenberg, 1999). The motorized unconventional forms of transportation have been slowly incorporated into several Alaskan cultures out of necessity beginning in the 1960s and 1970s (Brinkman, et al., 2014). They have evolved into the recreational vehicles of today that, despite their name, often remain the only forms of transportation usable in rural areas of Alaska (Figure 9). For example, Bethel has specific definitions for an ATV: a vehicle with three or more low-pressure, flotation-type tires, as designed by the manufacturer or altered, to be used as an off-road recreational vehicle (AS 45.27.390).

Figure 9. ATVs parked outside local store in Alaska

In the last year there has several events bringing into question the safety of ATVs and other unconventional modes being used on roads as primary transportation. A woman was killed when struck by an ATV in Akiachak when walking along a roadway (Klint, 2016) (Figure 10). Bethel has implemented stricter enforcement of no ATVs or Snowmachines on roads, subsequently issuing two dozen tickets in the span of a week (Demer, 2016) (Figure 11). Another article illustrates a confrontation between an automobile driver and an ATV driver where the automobile driver felt it was their responsibility to enforce the speed limit and no-ATV-on-roads policies (Dubowski, 2017). Lastly and most recently, an ATV driver was killed after his ATV departed from the Denali Highway to avoid colliding with an automobile (Boots, 2017) (Figure 12). These articles illustrate the need for further research and study into these modes and how they interact with existing transportation infrastructure and conventional modes of transportation.

Akiachak woman dies when struck by ATV

Author: Chris Klint Updated: October 3, 2016 Published October 3, 2016

A 76-year-old pedestrian was killed in the Western Alaska village of Akiachak late Friday when she was struck by an all-terrain vehicle, Alaska State Troopers said.

Figure 10. News article about a woman who is fatally struck by an ATV

Sudden crackdown on four-wheelers quiets Bethel streets and upsets residents

Author: Lisa Demer Updated: October 10, 2016 Published October 10, 2016

BETHEL — In the space of just days, a crackdown targeting four-wheelers and snowmachines on the streets in the rural Southwest Alaska hub of Bethel changed life for many.

The Bethel City Council on Sept. 27 passed two enforcement measures. Streets grew quiet. In the first week, Bethel police wrote more than two dozen tickets carrying $50 fines for four-wheelers illegally on the streets.

Figure 11. News article about enforcement of ATV restrictions

Anchorage man killed in ATV crash on Denali Highway

Author: Michelle Theriault Boots Updated: August 27 Published August 27

An Anchorage man was killed in an ATV crash on the Denali Highway Saturday, the Alaska State Troopers said.

Song Her, 50, of Anchorage, was riding westbound on the highway at Mile 92 of the road when his ATV "left the roadway and rolled down an embankment," troopers wrote in an online dispatch.

Troopers were told the ATV driver appeared to be trying to avoid a vehicle, said troopers spokesperson Megan Peters.

Figure 12. News Article about an ATV fatality on the Denali Highway

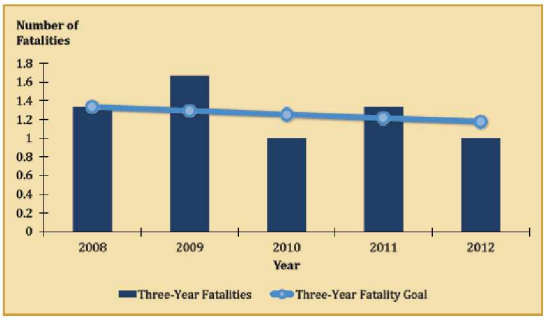
2.3 Safety

Safety is a challenge no matter what mode of transportation is used. It is often how modes are operated and in what context they are operated that create safety issues rather than the specific transportation mode. The following (Section 2.4.1 and 2.4.2) outline some of the common safety challenges related to conventional and unconventional transportation modes. The currently available data for unconventional modes is limited in general, but even more so in Alaska. Further research and targeted analysis of currently available data such as the Alaska trauma registry afford an opportunity to gain more insight into the potential safety issues the state of Alaska faces.

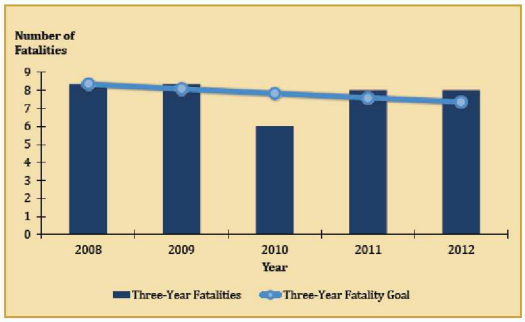
2.3.1 Conventional Mode Safety

Motor vehicle crashes are one of the top ten killers of people in the United States (Miniño, Arias, Kochanek, Murphy, & Smith, 2002). This can include motor vehicles and the crashes between motor vehicles and bicycles or pedestrians. There are more bicycle crashes in rural areas than in urban areas (Federal Highway Administration, 2010). However, 68% of bicyclist fatalities occur in urban areas (Federal Highway Administration, n.d.). While bicyclist fatalities in the United States dropped from 718 to 623 from 2008 to 2010, in 2012 they rebounded to 726 fatalities (USDOT, 2014). Alaska is ranked number 29 in the United States for most bicyclist fatalities (NHTSA Fatality Analysis Reporting System data, 2016). In 2001 there were 4,901 pedestrian deaths in the U.S., and 4,735 of those were related to traffic. The US also reported 78,000 pedestrian injuries in 2001 and 66,000 of those were related to traffic (Federal Highway Administration, n.d.). Since 2009 pedestrian fatalities have been steadily rising. This rise is an indicator that more research and broader research needs to be done on transportation safety.

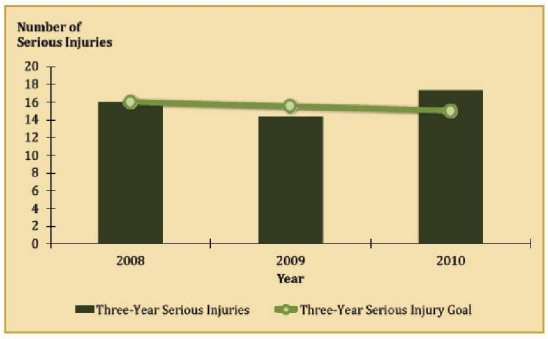
Figure 13 shows fatalities, serious injuries, and hospitalizations of bicyclists (a, b, and c) and pedestrians (d, e, and f) (AK DOT, 2013). For bicycles fatalities are below the projected value (a), but both serious injuries (b) and hospitalizations (c) are above the projected value and above the 2008 value. For pedestrians both fatalities (d) and serious injuries (e) are above the projected value and serious injuries are above the 2008 value. Pedestrian hospitalizations (f) are below the projected value and well below the 2008 value.



(a)



(d)



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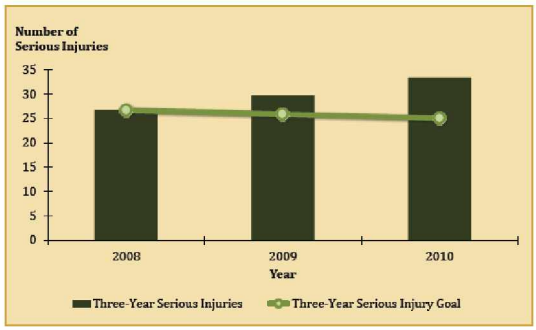

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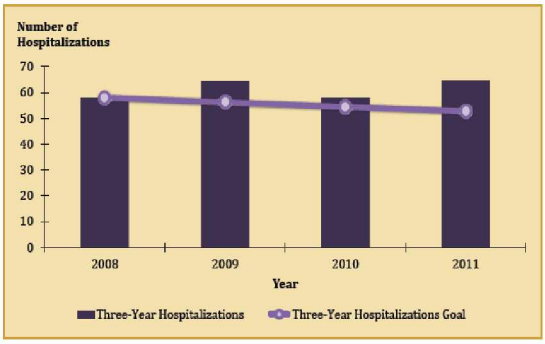
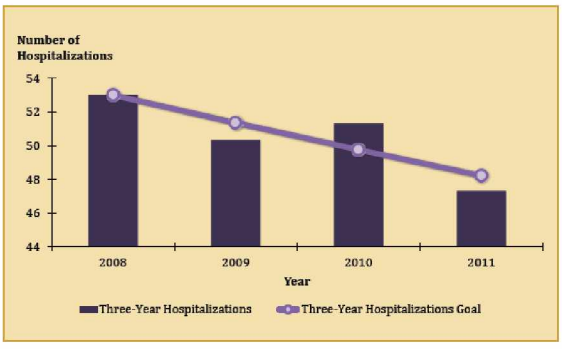


(c)



(f)

Figure 13. Actual vs. projected fatalities, serious injuries, and hospitalizations (AK DOT, 2013)

2.3.2 Unconventional Mode Safety

Unconventional modes of travel are not as regulated as conventional modes. There are no requirements for permits, operating licenses, or training of any kind. An estimated 77% of injuries suffered while operating an ATV are attributed to drivers under the age of 35, and 21% are attributed to drivers under the age of 16 (Garland, 2014). Even though ATVs are not permitted on most roadways 62% of ATV-related deaths between 1985 -2009 resulted from on-road crashes. The number of on-road deaths increases to 3 times more likely than off road deaths related to ATVs since 1998 (Denning, Harland, Ellis, & Jennissen, 2012). A large number of ATV users (94%) ride with more than one person (Jennissen, et al., 2012). From 1993-1994 the number of injuries, deaths, and hospitalizations related to snowmachine use was larger than those for on-road vehicles (Landen, Middaugh, & Dennenberg, 1999). As of 2003 snowmachines are responsible for approximately 200 deaths per year and 14,000 injuries (Pierz, 2003). ATVs and OHVs are not currently being studied by the DOT&PF in Alaska, however the DOT&PF did identify ATVs and Snowmachines as a "significant safety issue" in 2003 (AK DOT, 2013).

2.4 Data

There is currently very limited data on ATVs and snowmachines. The majority of the readily available data is for personal automobiles, bicycles, and pedestrians. While the Alaska DOT&PF, other agencies, and the news are concerned with safety in relation ATVs and snowmachine, especially when used on or near roadways, the data does not yet exist to support strategies and initiatives to improve safety.

2.4.1 Counts

As stated Earlier, Anchorage (the main metropolitan area of the state) has witnessed a 32% increase in bicycle usage from 2007 to 2008 at the annual bike to work event (Austin, et al., 2010). While the smaller town of Fairbanks has seen a more averaged usage pattern with usage spikes in 2012 and 2013, but then trends going down again to an a general middle value in 2017 (Figure 14) (Stevens, 2017).

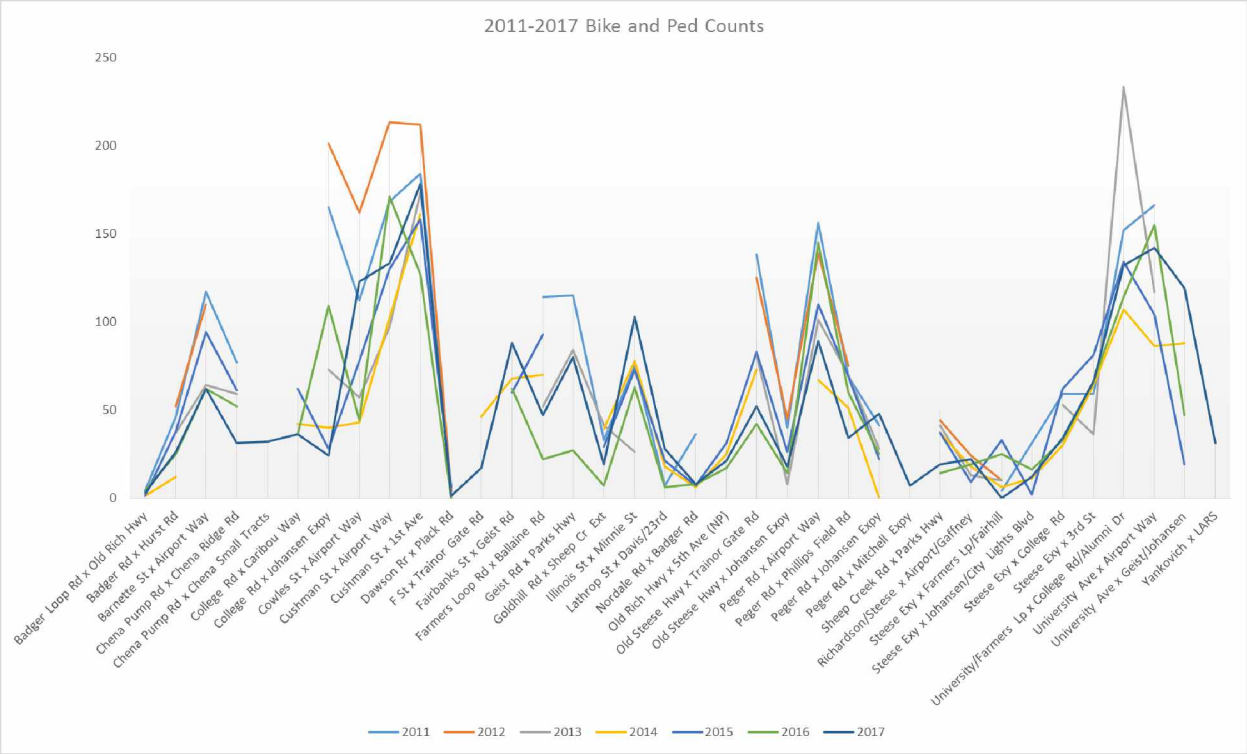


Figure 14. Fairbanks Alaska bicycle and pedestrian counts 2011 to 2017

2.4.2 Non-Reporting of Crashes

Non-reporting of crashes can be an issue when trying to determine the quantity and frequency of crashes in an area. Many states require that people report crashes if there was an injury or if the damage was over a certain amount such as $1,000 (Landers, 2016). However, this requirement does not mean that all crashes with an injury or large expense are reported. Hospital records can be helpful in capturing data for non-reported crashes, but there are still many crashes that are not reported and so data concerning injuries and crashes can often times depict lower numbers that what is actually occurring in a region or state (Federal Highway Administration, n.d.). Part of the research presented in this thesis includes analyzing trauma data from hospitals in Alaska.

Due to non-reporting of motor vehicle crashes it is sometimes necessary to use resources such as trauma registry data collected at hospitals. Unfortunately, in a state like Alaska, approximately 80% of all healthcare providers practice in and near Anchorage. This means that the remaining 20% (~300) physicians are spread across the state's remaining half million square miles. With such limited access to healthcare providers it is likely that even the trauma registry does not have a complete picture of traumas in Alaska (Alaska Federal Health Care Partnership, 2010). The primary issue with non-reporting is that it adds to the lack of good robust data from which we can make design/ policy based decisions. This directly supports the decision to use multiple sets of data in this research to better understand transportation safety issues.

2.4.3 Other Surveys

There are very few surveys that investigate the hazards of mixed traffic, (i.e., automobiles, bicycles, ATVs, etc. operating in some proximity to each other). Of these, more focus is given to automobile and bicycle/pedestrian interactions than there are for unconventional modes. One such survey aimed to examine, "the comprehensibility of three traffic control devices" related to Automobiles and Bicycles (Hess & Peterson, 2015). While this interaction is important to study there is still the need to better understand other interactions such as those between Automobiles and ATVs. The New England Travel Survey (NETS) asked questions related to proximity to town centers and certain aspects of connectivity; however it does not address mixed-use scenarios (Coogan, Gibson, & Campbell, 2010). The National Household Travel Survey (NHTS) asked questions related to trip purposes, types of transportation used (though no unconventional modes mentioned), and times of day/ days per week that people travel (USDOT, 2009). The NHTS also does not ask questions about mixed-use.

Though there are surveys and data on safety and fatalities of ATV and snow machine users, to the best of our knowledge there has been no survey on the frequency or extent of their use (i.e., yearly miles traveled) or how much of this is utilitarian and/or occurring on pubic roadways. Similarly, no studies were found which address the interaction of non-motorized and non-conventional forms of transportation in a mixed-use context.

2.5 Existing Policies

There is a wide range of policies and laws concerning where unconventional motorized modes such as ATVs and Snowmachines are allowed to travel, what safety features these modes should have, and what safety equipment should be worn while operating these modes. For example in the state of Alaska ATVs and Snowmachines are permitted on roadways in order to cross a highway, or when traversing a bridge or culvert but only to the far right edge of the road, or when road conditions are impossible, due to snow or ice accumulation (see Alaska statutes 8.15.010 – 18.15.130 for a full list). However, in Nome it is expressly prohibited for off highway vehicles to be operated on highways and unlawful use on roadway is subject to a fine and a mandatory court date. The fines vary from $50 for the first offense, $75 for the second offense, and $150 for the third offense. Bethel, on the other hand, has a more lenient policy allowing ATVs to operate on city roads if they comply to certain conditions such as: staying on the correct side of the lane of traffic, may not pass other moving vehicles, may not weave in and out of traffic, may not operate in a careless or reckless manner, and must be under 1,500 lbs including cargo. Kotzebue has determined that no one under the age of 16 will be allowed to operate an ATV, snowmachine, or other similar mode, and all vehicles must be insured for road use and registered with the Alaska DMV. Kotzebue also has a fine scale for offenders $25.00 for first offense up to $100.00 for the fourth or any subsequent offences. Failing to stop at a stop sign is a more serious offence and caries a fine of $110. The Haines Borough has similar regulations, but also has a more detailed document that defines the types of modes, required papers, and operational rules (Haines Borough, 2014). In general the rules, regulations, and even availability of documentation such as maps vary widely depending on each individual place.

There are not any absolute commonalities between places, so ATV and Snowmachine users need to look up the regulations for their area before operating on or near roadways.

The laws for bicycles are relatively straight forward. Bicycles operating in the road are subject to the same laws and responsibilities of any other vehicle in the roadway. Cyclists are not allowed to carry passengers except for bicycles equipped with extra seats or small children in backpacks. A bicycle may not be pulled by a motor vehicle. Bicycles should ride in the same direction as traffic and use hand signals to notify other vehicles of their intended direction changes (AK DOT, 2003). There are not a lot of explicit consequences for not following bicycling laws, but in general a $25 fine is common.

Pedestrians are expected to obey all traffic control devices. Pedestrians are not permitted to cross roadways except at designated cross walks. Lastly, pedestrians are not allowed to solicit rides or work in a way that may be distracting to drivers. Pedestrians are encouraged to wear bright colors and reflective gear for safety (Inderrieden, 2015). If a pedestrian crosses a street not at a cross walk or against the light at a cross walk will result in a $25 and $40 fine respectively. There are currently few to no laws restricting dog mushing use, however recently the Matanuska-Susitna Borough has enacted regulations to protect historically dog friendly trails and ensure mushers are still able to keep their dogs at home without receiving noise complaints from neighbors (Hollander, 2016).

Certain areas of Alaska have user restrictions either for safety reasons, or user requirements. For example sidewalks are restricted to non-motorized travel only. However, other areas like the trails in the Goldstream Valley in the northern region of the Fairbanks North Star Borough allow all modes of transportation, and the varied modes often work in harmony with snowmachines blazing trails, and dog mushers compacting and widening those trails, and skiers further improving the texture of the terrain. These trails often cross roadways, but due to designated crossing areas the risk of being hit by another mode of transportation is likely more limited than if there were not designated crossings.

Helmet laws also vary depending on geographic location. There are many states (e.g., Alaska) that do not require helmets for any activity. However, some communities such as Bethel require minors to wear helmets for all activities including bicycling, and operating ATVs. Other communities like Nome strongly recommend wearing a helmet when riding an ATV but do not require their use. See the below map of the United States helmet regulations (Figure 15). About half of the states (most of them with large rural areas) do not require helmets to be worn while bicycling or any other activities (except for motorcycling).

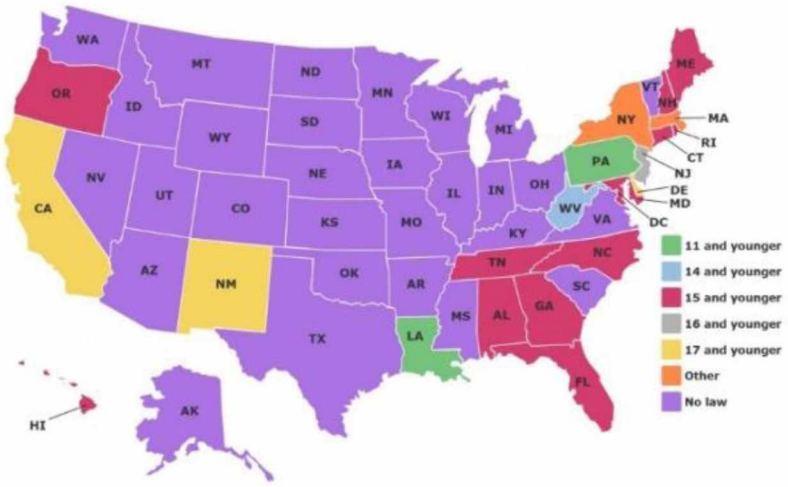


Figure 15. State bicycle helmet regulations map

2.6 Design Practices

Agencies such as the Bureau of Land Management (BLM) and the U.S. Forest Service have been instrumental in aiding in the development of trail design. Contrary to popular belief, trails are not simply small roads in the woods; there are many factors such as sight lines, terrain, and weather conditions that go into creating a safe and usable trail (Orth, 2016). Trail development often has more unique challenges than road development. Due to the limited availability of funds for trail design and maintenance volunteers are often needed to help. Trails also have different criteria than roads. A good trail has the following: sequence, access, rhythm, and design variations between enclosed spaced and open ones. A trail that fails in one or all areas will not be functional or enjoyable for users (National Park Service, 2007). Roads, on the other hand, are designed to be efficient and functional. There are a few scenic drives, but the majority of historic road construction is purely functional. More modern concepts such as context-sensitive solutions are being applied to road and city planning, but they are not yet the norm in the United States.

Some trail systems like Birch Hill Recreation Area are completely separated from roadway systems, only allow certain types of users (non-motorized), and have a specialized maintenance crew paid for by the Nordic Ski Club of Fairbanks. Other trails such as the Goldstream Trails cross multiple roadways, allow for any type of user, and have a very informal maintenance practices. There are also informal trails like the ones seen next to the Richardson Highway (HW 2) that are not maintained and exist purely because people use them and wear down the vegetation into a pathway (Figure 16). In order to provide safe crossing for different modes, it is best design practice to install crossing signs so automobiles know to expect other modes to cross at that point. It is also best to have the crossing at equal grade to ensure safety and visibility (Noyce, 2013). Unfortunately with unofficial or unmaintained trails the crossings are not usually marked and are not at the same grade of the road making the intersections "blind" (Figure 17).

Figure 16. Informal trail next to the Richardson Highway near Delta Junction (Google, 2017a)

Figure 17. Example of a trail crossing Lawlor Road in Fairbanks not at grade, with no signage, and on a blind corner (Google, 2017b)

2.7 Conclusion / Need for This Study

Due to the vast rurality of Alaska and varied cultures across the state, understanding unconventional transportation methods especially on and near roadways is important. Both unconventional and conventional modes of transportation are used in urban and rural areas of Alaska. However in isolated regions where automobiles are sparse or nonexistent unconventional modes serve as the only modes of transportation. There are clear safety concerns regarding the use of unconventional modes in conjunction with conventional and non-motorized transportation modes. These safety concerns are further exacerbated by a lack of data to inform design and policy. The existing policies for transportation mode use widely vary depending on location for unconventional modes. This can lead to confusion and frustration on the part of users.

This study is essential because it addresses previously ignored modes of transportation both in terms of design and legislation. To better understand these modes, their needs, and the safety impacts further study needs to be done on this topic area. Alaska has committed to work toward

zero deaths with the motto "Every One Counts on Alaska's Roadways". In order to achieve this objective, statewide safety efforts should consider all modal users. This research presents a starting point by collecting and organizing data on unconventional and non-motorized use in the State of Alaska.

3 METHODS

Several methods of data collection and analysis were used in this research to fill the knowledge gaps of unconventional transportation mode use and safety. First, a regional transportation survey was developed and administered in order to obtain real world feedback on mode use on and near roadways and perceived safety concerns. The data from this survey was then analyzed and modeled to determine what factors contribute to ATV and snowmachine users feeling they have adequate access to trails. Before the survey could be sent out all team members had to get Institutional Review Board (IRB) approval and receive training. Second, data from the Alaska Trauma Registry was obtained from the Division of Health and Public Safety, scrubbed, and analyzed. This data set provides counts for the number of traumas that occurred from 2004 to 2011 and what modes of transportation were being used or where involved when the trauma took place. Third, a connectivity analysis was performed using existing and publicly available geographic information system (GIS) trail and roadway data. Using trail and roadway networks a level of connectivity could be assigned to each populated place. The survey models for safety and connectivity connect the survey with the trauma and GID data respectively. The last connection is made by mapping the traumas by location and transportation mode type. These three sources of data and the resulting connections provide an informative path to achieving the primary project objectives and there by better understanding what factors contribute to safety and mobility, as well as where traumas occur (Figure 18).

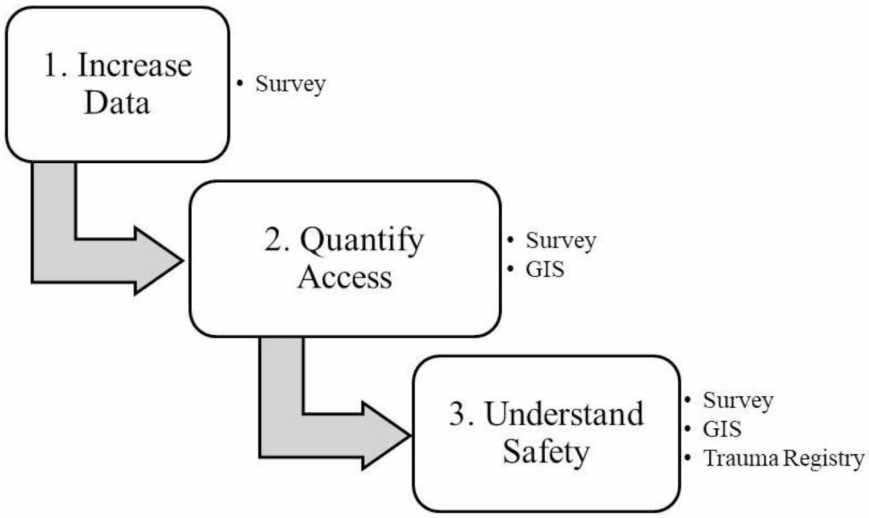


Figure 18. Primary project objectives and corresponding data

3.1 Survey

The Pacific Northwest Transportation Survey was developed by the University of Alaska Fairbanks and the University of Idaho. The survey received exempt status by IRB, see documentation in the Appendix B. The objective of this survey was to gain further insight into users of unconventional modes of transportation, if they use these modes on or near roadways, and if they have any safety concerns while operating these modes. The survey was developed from April 2016 through August 2016. There were several pilot surveys sent out to experts in the use of particular modes like 2015 Yukon Quest champion Brent Sass. The survey was also sent to people for general comments about the length and content of the survey. The survey went live on August 23rd 2016 and was closed on October 31st 2016. This survey is an observational study of users of different types of modes in the State of Alaska and was specifically designed to target the modes that are used on or near roadways.

3.1.1 Question Development

Questions were developed initially by writing a list of topics and questions that related to unconventional mode use on or near roadways that were not being addressed in current studies. This list included broad topics such as residence characteristics and vehicle ownership, and more specific areas such as utilitarian versus recreational use and types of safety equipment used while operating a transportation mode. The NETS and the NHTS were also taken into consideration and some questions such as proximity to town center, trip purposes, and types of transportation used were developed to mirror the language found in these surveys. There were several pilot surveys sent out to experts in the use of particular modes like 2015 Yukon Quest champion Brent Sass. The survey was also sent to people for general comments about the length and content of the survey such as Geoffrey Orth and Shane Arnold. The final questions were then organized and replicated for each mode to make comparisons between modes easier. In some cases questions differed between modes. For example, bicycles and pedestrians were asked if they felt there were adequate paths within a ¼ mile of where they lived because transportation research indicates that on average people will not walk more than ¼ mile to reach a facility. In contrast, ATV and snowmachine users were asked if there were trails near their home since there is not research indicating a maximum distance a person will travel via and ATV or snowmachine. Examples of the survey questions can be found in Figure 19, and the complete survey can be found in Appendix C.

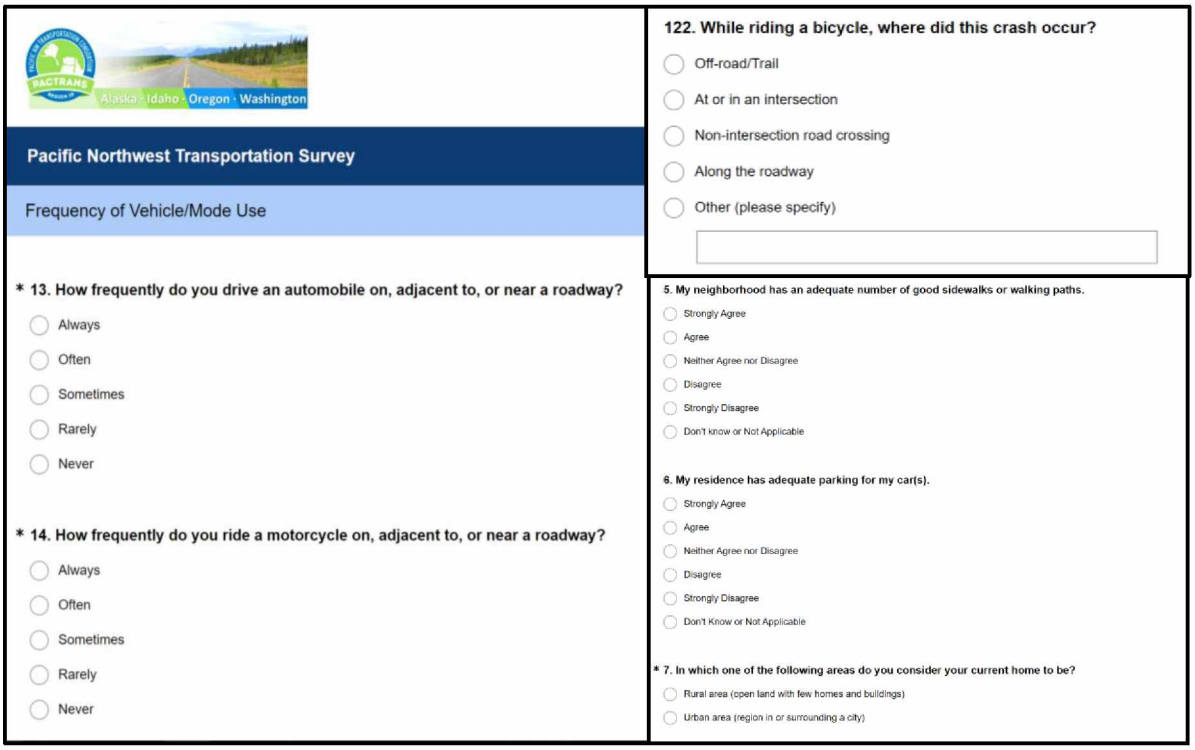


Figure 19. Examples of Pacific North West Transportation Survey questions

The survey logic and format follows the same pattern regardless of transportation mode selections. The only difference is that if a respondent used more than one transportation mode on or near roadways more frequently than never they would receive questions for any transportation mods which that criterion applies. The survey framework is shown in Figure 20.

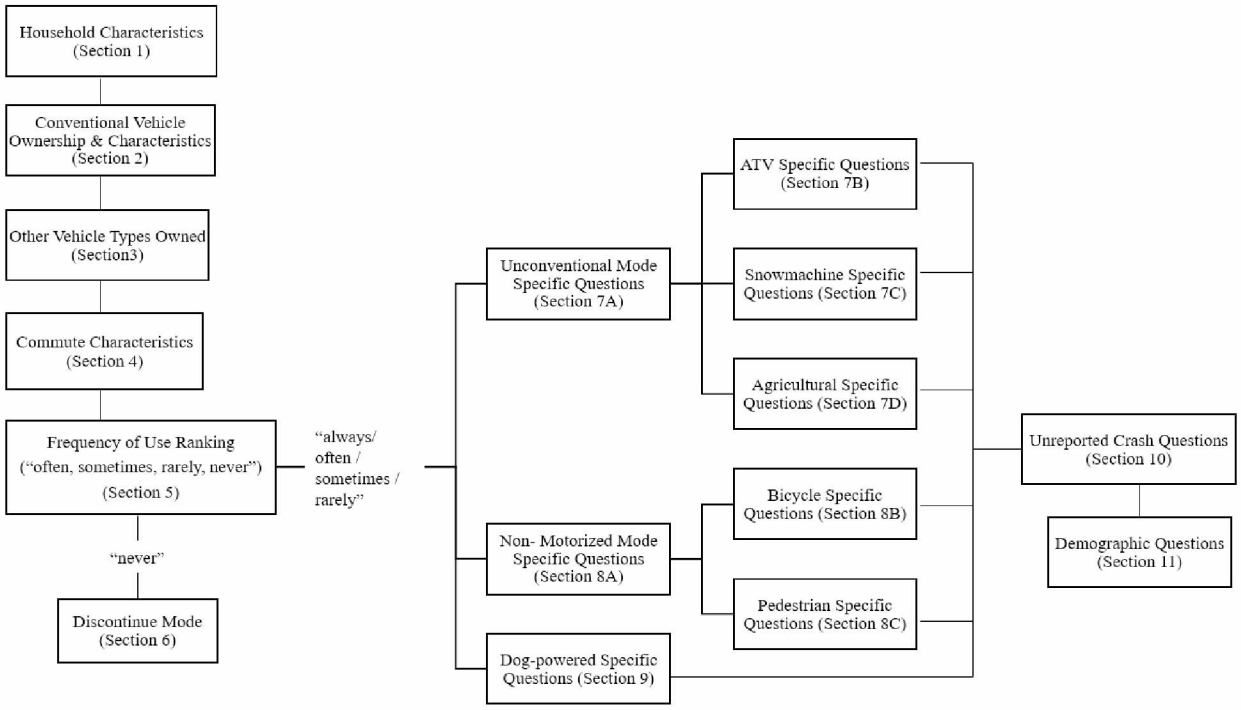


Figure 20. Pacific North West Transportation Survey framework

3.1.2 Survey Distribution

The survey was distributed by the University of Alaska Fairbanks and the University of Idaho. Distribution was targeted toward users of transportation modes of interest such as ATVs, snowmachines, bicycles, pedestrians, and dog powered. The distribution list included but was not limited to sporting groups such as running clubs, ATV, and snowmachine clubs. The survey was also sent to transportation agencies, local municipalities, and native corporations across the state. By targeting specific user groups the goal was to ensure sufficient numbers of responses across all modes of interest. The same e-mail was sent to all organizations inquiring if they would be willing to distribute the survey to their contacts lists and post through their online channels. Additionally, an exhaustive list of organizations and contacts was developed so that the survey would be distributed to all known groups and organizations with in the state of Alaska that fall under the following categories:

- Villages and Alaska Native Groups
- Transportation Agencies for Cities and Boroughs
- Dog Mushing and Skijoring Clubs and Organizations
- Running clubs
- Bicycling clubs
- ATV Clubs
- Snowmachine Clubs
- Alaska State Parks

Initial contact was made via e-mail to ask if the group or organization would like to distribute the survey to its members. If the primary contact for the group/organization agreed, a follow-up email was sent that contained a link to the survey and a brief description of the nature and intent of the survey. A random drawing for $25 Amazon gift cards (10 from each state) was used as an incentive for people to take the survey. The survey was open for responses between August 23rd, 2016 and October 31st, 2016. The drawing for and distribution of the gift cards was done after the survey had closed. In order to keep the initial survey anonymous, respondents were redirected to a second and independent survey for the gift cards after completing the PNW Transportation Survey in order to input a mailing address or contact information. Figure 21 depicts the survey responses (of the initial survey) mapped by reported zip code.

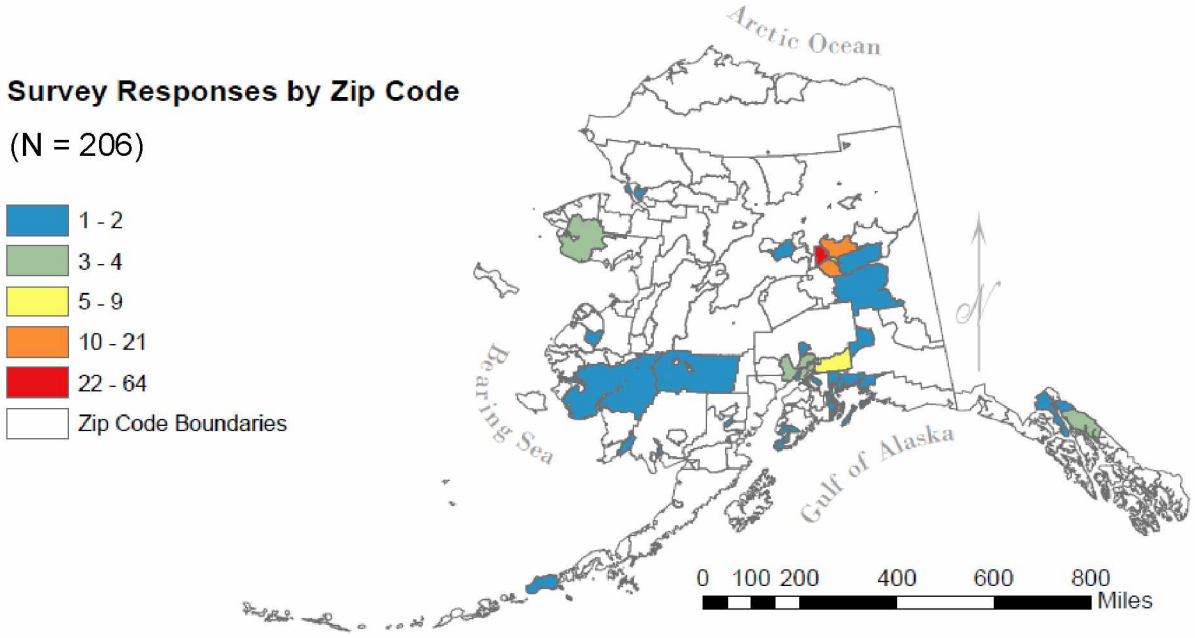


Figure 21. Map of survey respondent locations based on reported zip code

3.1.3 Analysis Methods

The primary software used for statistical analysis was SPSS. Initial analysis consisted of comparing different categories of responses to find potential associations in the data. Second, paired chi-squared analyses were performed to test for independence of variables. Finally, predictive models were developed to define areas of interest such as trail availability near homes, and safety perceptions in mixed-use scenarios.

Association, or level of relationship between variables, was determined by doing a series of chi-square tests of independence which compared a response variable (e.g. perceived trail access) by a factor level variable (e.g. rural or urban residential area). Over 200 variable pairs were tested. The test statistics for the chi-square tests of independence are denoted as χ^2. The null and alternative hypotheses are as follows:

H_o = Variable 1 is independent of Variable 2

H_a = Variable 1 is not independent of Variable 2

The equation for calculating χ^2 is below:

$$\chi^2 = \sum_{i=1}^{R} \sum_{j=1}^{C} \frac{(r_{ij})^2}{e_{ij}}$$

$$r_{ij} = o_{ij} - e_{ij}$$

$$o_{ij} = the\ observed\ cell\ count\ in\ the\ i^{th}\ row\ and\ j^{th}\ column\ of\ the\ table$$
$$e_{ij} = the\ expected\ cell\ count\ in\ the\ i^{th}\ row\ and\ j^{th}\ column\ of\ the\ table$$

$$e_{ij} = \frac{row\ i\ total * col\ j\ total}{grand\ total}$$

The calculated χ^2 value is compared to the critical value from the χ^2 distribution table. The critical value is selected by using the degrees of freedom (df) equal the number of rows minus one times the number of columns minus one ((R-1)*(C-1)), and the chosen type-I error rate (usually 5%). If the calculated χ^2 value is greater than the critical χ^2 value, then the null hypothesis is rejected. The p-value can also be used as a rejection criterion. If the p-value is less than alpha (α) then the null hypothesis is rejected. For a 95% confidence interval the value of alpha is 0.05 or 5 percent.

3.1.4 Recoding Survey Data for Modeling

In order to better understand what factors contribute to perceived access to trail opportunities, several models were analyzed. The two modes studied were ATV and snowmachines. Dog powered modes could not be modeled because of the low number of respondents for that transportation mode. Bicycles and pedestrians were not modeled because: 1) time constraints due to the immense level of effort required to clean the survey data for modeling; and 2) considerable and exhaustive research has already been done related to bicyclist and pedestrian access and safety.

The predictive models were developed by first breaking up the data by mode by using the survey question, "How frequently do you drive/ride transportation mode on, adjacent to, or near a roadway?" with "transportation mode" being ATV, or snowmachine, bicycle, or walk. If a respondent selected any response other than "Never" they would receive follow-up questions related to that mode. Additionally, questions that had an "other" category where respondents could write in an answer were deleted so that only numeric values remained for modeling. Lastly, variables with no usable data, i.e. all missing values, were deleted as well.

There were three primary types of questions that needed to be recoded. First, starred questions limited a respondents view of questions based on their answer to a question with a (*) next to it. Secondly, variables where respondents could "select all that apply" fragmented into several variables. These variables had values of either "1" if they selected an option or "." (i.e., a

missing value) if they did not select an option. Thirdly, questions that were asked in a dot matrix format so as to limit the number of overall questions and make it easier for the respondent to answer quickly. These questions fragmented out into multiple variables, and the values for each variable was "1" though however many selections were available.

Variables with a star (*) were coded so that respondents only viewed a series of subsequent questions if they answered the stared question a certain way. An example of this is question 66 (Figure 22). The question asks if the respondent has ever been in a crash with an automobile while riding a snowmachine. If the respondent selects "Yes" they see the subsequent questions (Figure 23). If the respondent selects "No" or "I prefer not to answer" they do not see the subsequent questions.

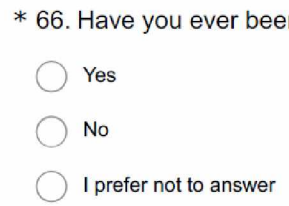


Figure 22. Starred question which limits the view of subsequent questions depending on the respondents answer

The recoding procedure is as follows:

1. Identify starred questions.
2. Make note of these and the affected questions because they have to be coded based on the assumption that if the respondent answered "Yes" to the starred question that they saw the subsequent questions, and if they answered "No" they did not see the subsequent questions and their answer to all those questions would also have been "No."
3. Recode missing values to zero or another appropriate value when they should be a "No" rather than a missing value. The subsequent questions were recorded by doing a transform and then selecting "recode into same variables". In the recoding window the aforementioned subsequent questions are the variables selected under "numeric variables." Then an "if statement" can be used to recode the missing values to zero.

In the example, Figure 22, that is questions 67 through 72. An "if statement" was used to select only the cases where the starred question (question 66) was answered "No." None of the respondents selected "I prefer not to answer" so that did not need to be coded. The selected cases were recoded to zero to indicate an answer of "No" to that question.

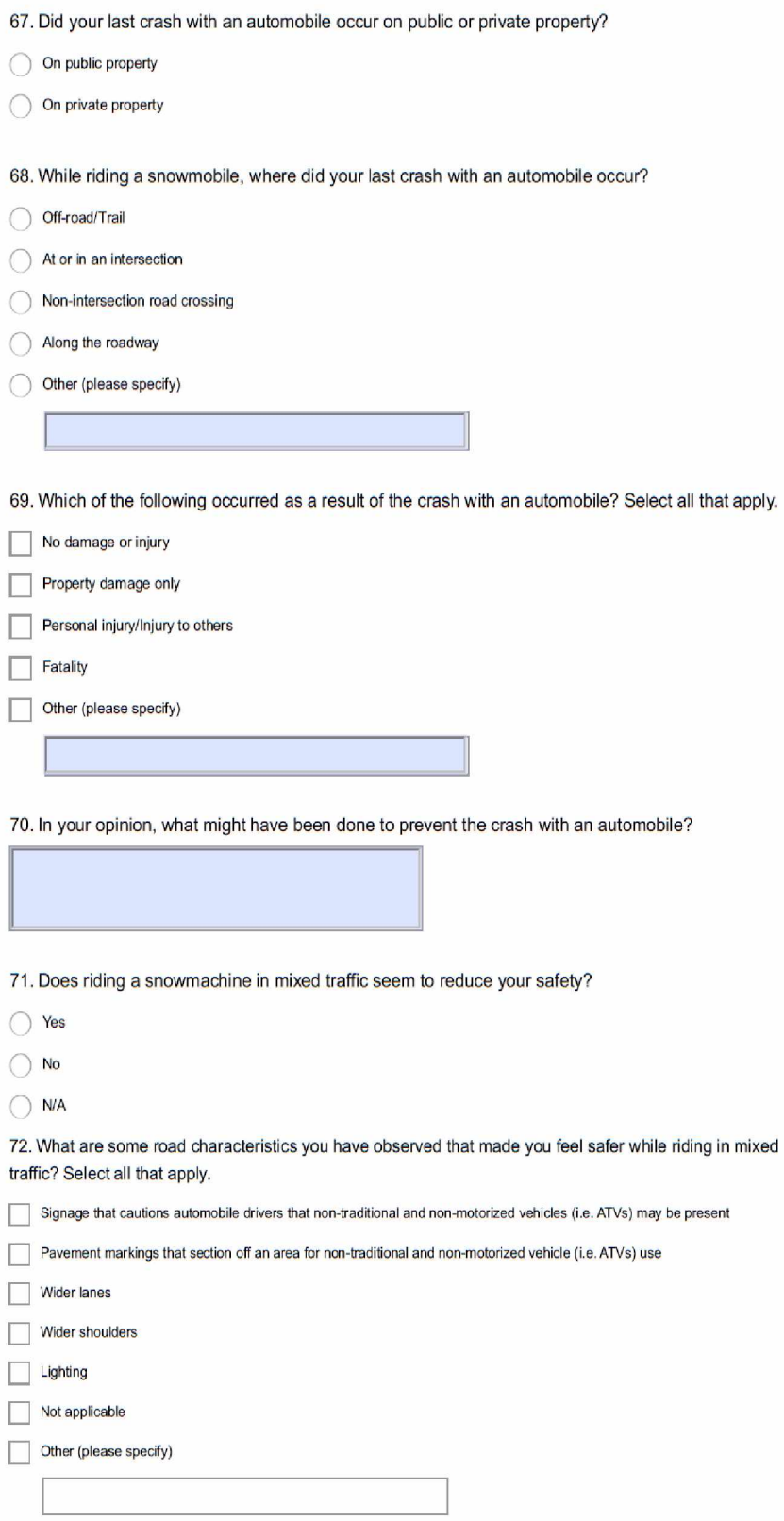


Figure 23. Subsequent questions that the respondent only sees if they answer "Yes" to the starred question

Variables that had the option to "select all that apply" (Figure 24) first needed to be recoded to have more than one value because an analysis cannot be done on a variable with a single value. This was accomplished by making the assumption that if the person selected at least one of the available options they intentionally left the other options blank. This made it so that the only missing values were for variables which a respondent did not select any of the options. The variables that were previously coded as missing now became a "0" to indicate that the option was purposeful left blank and the person did not identify with that option. The recoding process used the transform and recode into same variable options. The numeric variables were the fragmented variables: House (not on farmland or open space) (q0002_0001), House (on working farmland, in major open space, or secluded wooded area) (q0002_0002), Apartment, townhouse, condominium, multi-family house (duplex) (q0002_0003), and Dormitory or other institutional housing (q0002_0004). An "if" statement was used to select the appropriate cases: q0002_0001 = 1 | q0002_0002 = 1 | q0002_0003 = 1. Old and new values were defined as: 1 = 1, else = 0.

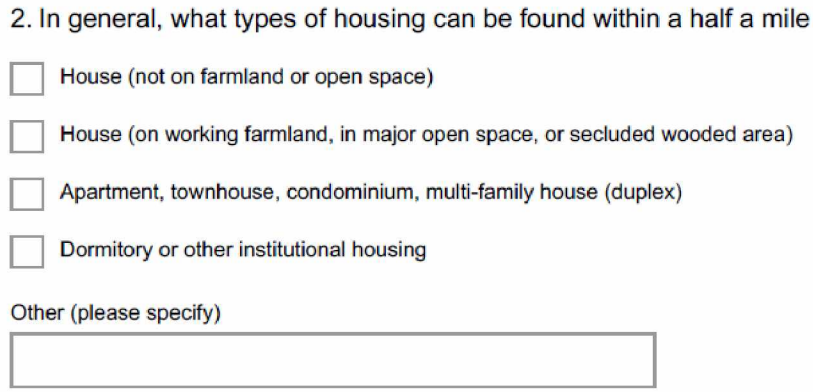


Figure 24. Example of "select all that apply" question format

If a "select all that apply" question was inside a section of "subsequent variables" (as in Figure 23) the missing values were recoded to "2" instead of zero since "0" had been used for the "No" selection. Once the questions are recoded they can be consolidated into a single variable. For the "select all that apply" questions that is accomplished by creating a new variable. Using question 2 in Figure 14 that new variable would be called "q0002". In order to retain all of the information in the separate variables the new consolidated variable needs to be recoded to include every possible combination. For Question 2 there are four options to select from so there are a total of 15 combinations. These combinations are seen in Table 1.

A = House (not on farmland or open space)

B = House (on working farmland, in major open space, or secluded wooded area)

C = Apartment, townhouse, condominium, multi-family house (duplex)

D = Dormitory or other institutional housing

Table 1. All possible combinations for a four option "select all that apply" question

		A	B	C	D
1	A	1	0	0	0
2	B	0	1	0	0
3	C	0	0	1	0
4	D	0	0	0	1
5	A&B	1	1	0	0
6	A&C	1	0	1	0
7	A&D	1	0	0	1
8	B&C	0	1	1	0
9	B&D	0	1	0	1
10	C&D	0	0	1	1
11	ABC	1	1	1	0
12	ABD	1	1	0	1
13	ACD	1	0	1	1
14	BCD	0	1	1	1
15	ABCD	1	1	1	1

The new variable "q0002" now has the values 1-15 but only the values which match the combinations that were present in the original data. Often only 5 or 6 combinations are present in the new variable. However, since each combination was coded it is possible to select analyze and descriptive statistics and select "frequencies". This will give a table of the combinations that appeared and how many times they appeared. Using this table the relevant values were coded with descriptions. For example, a value of 7 references a combined selection of A and D. The resulting description for the value of 7 would be: House (not on farmland or open space) & Dormitory or other institutional housing. This was done for all combinations that appeared in the new variable.

The final variable types that needed to be recoded were questions that presented in a dot matrix format (Figure 25). These questions were more complicated to consolidate to a single variable because of the large number of possible combinations. Instead of recoding a single variable to account for every combination, new variables were computed to reflect the most useful information in the question. For example, Question 9 in Figure 24 a new variable "q0009_rat" was coded to show the ratio of ownership of ATVs (or the mode of interest) to automobiles.

This ratio could be used to indicate the number of a particular mode a respondent owned in relation to the "standard" transportation mode of the automobile. Question 12 in Figure 26 was handled differently. For this question only the mode of interest was retained. A new variable "q0012" was created, and a value of "1" was coded if at least one of the trip purposes used the mode of interest, and a value of "0" was coded if none of the trip purposes used the mode of interest. The description for this question was, "At least one of the following trip types used the mode of interest: to go to work, school, shopping, fun/entertainment, grocery shopping, or for work."

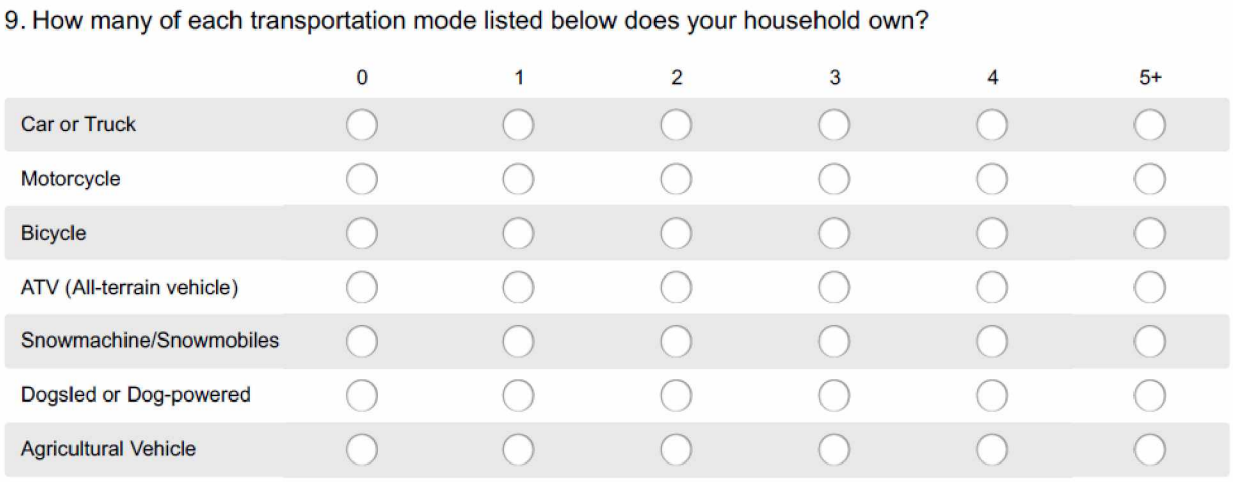


Figure 25. Matrix question format for transportation mode ownership

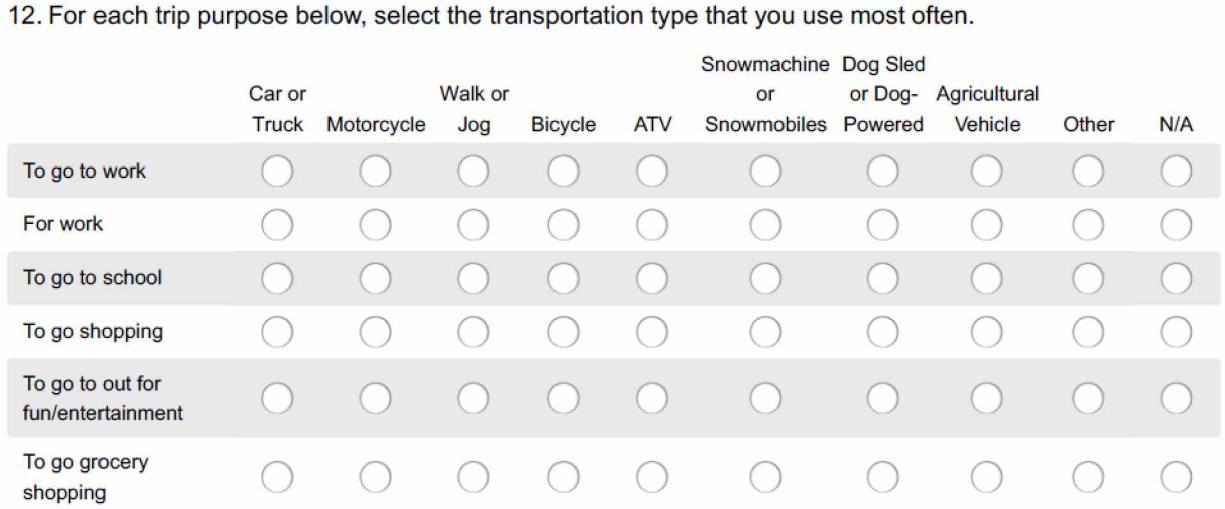


Figure 26. Matrix question format for trip purpose by mode

3.1.5 Modeling Methods

The initial step used to determine the model was a forward selection algorithm in a linear regression model fit to the data, hereafter called a linear forward pass. The response variable is logarithmic in nature based on the distribution test in JMP and primarily consists of categorical variables. However, the linear forward pass is a viable method for reducing a large pool of potential variables to a relevant group to begin modeling from. After the linear forward pass is performed the model can be tested using a cumulative logit procedure. This initial model can also be adjusted by adding variables that potentially should be in the model and removing variables that do not make logical sense in the model.

The initial linear pass starts with the intercept only and then adds one variable at a time to test if the model improves or not. The first stage of the forward pass tests all possible models that have the intercept and one additional variable. The SPSS software performs an F-test on all potential models and selects the model with the lowest p-value, provided the p-value is less than alpha ($\alpha = 0.05$). The process then starts over again and SPSS fits every possible model that adds another predictor. This selection process chooses predictors one at a time with the lowest p-value providing the p-value is always less than alpha ($\alpha = 0.05$). The forward pass stops once the addition of any predictor to the model results in a p-value greater than alpha ($\alpha = 0.05$).

When the linear forward pass is complete the final model is reported in the SPSS output. All rejected variables are also listed. This final model is then run through a cumulative logit model. The output for a cumulative logit model gives the estimated values (beta values) for the model. Each beta has a chi-squared value and a p-value which indicates the model's level of fit and significance to the model. SPSS reports goodness-of-fit of the model which includes the deviance, the Akaike's Information Criterion (AIC), and the Bayesian Information Criterion (BIC) values. SPSS also reports the omnibus test which shows the better than thresholds only model. The predicted category values should be saved to do assess the models predictive skill.

Important assumptions for the multinomial cumulative logit model include the assumption of response independence, and a representative sample. Given the method and procedure, independence is assumed. The survey did obtain responses from a wide range of areas in Alaska (Figure 21). Specific groups were targeted in order to over-sample small subpopulations, so this could potentially introduce bias. Additionally, since the survey was sent to groups rather than individuals and we did not request a list of members that the survey was sent out to, it is not possible to estimate non-response rates.

3.2 Trauma Registry Data

The Alaska Trauma Registry data was obtained by filing a request form via e-mail with the Department of Health and Social Services to help fill in current data gaps from non-reporting of crashes related to modal safety. An "Injury Surveillance Data Elements List" was filled out to select specific variables of interest (e.g. place, cause, BAC, etc.), and two forms had to be signed. The first was a "Release of Information Policy" and the second was a "Confidentiality Statement". The trauma data is the compilation of data from 2004 to 2011 of hospital records of

traumatic injuries. A traumatic injury is defined as a physical injury of sudden onset and severity which require immediate medical attention. The raw data was not in a form that could be easily analyzed. The raw data had a total of 367,326 records each with 26 individual fields of corresponding information. The columns "placespec" and "injcause" were used because they had data that seemed most relevant to this study. The variable "placespec" reported the specific place where the trauma occurred (e.g. at home, intersection, wilderness, etc.). The variable "injregion" was used to identify the spatial location in Alaska where the trauma occurred (e.g. Fairbanks, Anchorage, Kotzebue, etc.). The variable "injcause" indicated the thing or type of event that caused the trauma. This column is important because it identifies the mode being used in the case of a transportation related trauma event (e.g., ATVs, snowmachines, automobiles, and bicycle, pedestrian).

3.2.1 Organizing Data

First, the data needed to be sorted by injury cause to eliminate non-transportation mode causes for injuries, and secondly by the place where the trauma took place. However, since there were so many different and misspelled entries for injury places the entries needed to be sorted into categories. For example road was spelled out the following ways: On roadway, road, road, road-icy, road – icy conditions, road/ highway, road/street, roads, roadway, roadway in front of home, roadway/intersection, roadside, and rural road. These categories can be seen in Table 2 and were developed by manually reading through each unique place of injury. Note the category titled arctic man. This is a sporting event in Alaska where people race snowmachines while pulling people on skies. During the process of categorizing the places there would often be several types of spellings/misspellings for the same place or location. Not all of the spelling variations were correct spellings and others were abbreviations. The categories made it possible for further analysis to be performed on the data. There was one additional category called "unusable" which referred to places that did not fit in any category or were unintelligible.

Table 2. Trauma data subcategories

Road	Road Name Near Road Road Type Intersection Address Mile Posting
Other Transportation Infrastructure	
River / Water	
Rural Non-Road	
Arctic Man	
Parking Lots	
Public Area/ Parks	
Path / Trail	
Racing / Track	
Personal Property	
City/ Town	
Private/ Commercial Property	
Other / Unknown	
Blanks	

3.2.2 Analysis Methods

Once the data was organized into categories counts could be performed for various transportation modes. The transportation modes selected from the "injcause" were: ATV, snowmachine, bicycle, pedestrian, animal powered, and motor vehicle (automobile). Because all of the possible "placespec" descriptions were categorized the data could be sorted by mode and then counts for the number of times a descriptor occurred in a category.

Percent of total traumas by mode were calculated to show the ratios of various trauma locations using various transportation modes. The data was further consolidated into trauma events that occurred on/near roads, on paths/trails, and off road.

3.3 GIS/ Mapping Data

There are known areas of Alaska that are disconnected from one another due to transportation infrastructure being primarily centered along one corridor of the state. Outside of this corridor the transportation infrastructure is limited. The objective of this project is to better quantify the level of connectivity. Don Young stated that 82% of communities are not on a connected road system (Young, 2017). This research uses publicly available data of road and trail networks to identify connected and isolated places. Only trails outside of one-half mile are considered as trails within one-half mile of roads and highways are considered complimentary to the existing transportation infrastructure rather than supplemental. The reasoning behind this assumption is that current research indicated that the average person is not willing to walk more than a half mile to get to destinations or events. Therefore, any trail networks outside that distance is considered to be supplementary to the road network since it would be reasonable to expect that a person could then access that location or area on foot from the highway and road network. Results indicate that 72 of the 355 census populated places (20%) are only connected by trail, and 97 places (27%) are not connected at all.

Table 3 and Table 4 show the source and accuracy of the vector and raster data used in the connectivity analysis.

Table 3. GIS vector data

Name	Description	Source / Publication Date	Scale / Accuracy
Highways 63,360	*Highways in Alaska*	*ASGDC / 2006 http://www.asgdc.state.ak.us/*	*Unknown (Maybe 1:63,360)*
Secondary Roads 63,360	*Other Roads in Alaska*	*ASGDC / 2006 http://www.asgdc.state.ak.us/*	*Unknown (Maybe 1:63,360)*
Trails 63,360	*Trails in Alaska*	*ASGDC / 2006 http://www.asgdc.state.ak.us/*	*Unknown (Maybe 1:63,360)*
AK_Places	*Populated Areas of Alaska Based on Census Data*	*Lab Class / 2010*	*Not available in my copy*

Table 4. GIS Raster and satellite data

Name	Description	Source / Publication Date	Scale / Accuracy
Aster Dem	*Aster Digital Elevation Model of Alaska*	*Alaska Mapped http://www.alaskamapped.org*	*10-meter accuracy*
BDL: High Res	*Satellite view, high resolution imagery of Alaska*	*Alaska Mapped http://www.alaskamapped.org*	*25-meter accuracy with select areas of 1-meter accuracy*

3.3.1 Cleaning Data/ Rectifying Errors

Below are the definitions of the primary errors found in the original vector data for roads and trails (see Figure 27 and Table 5 for more detail):

- Janks - network features that otherwise deviate from a known or well matching feature part.
- Overshoots - network features that extend beyond the known or well matching feature distance.
- Shies - network features that do not meet when known or well matching features indicate they should.
- Separations - network features that are moved/ translated in space from known or well matching feature locations.

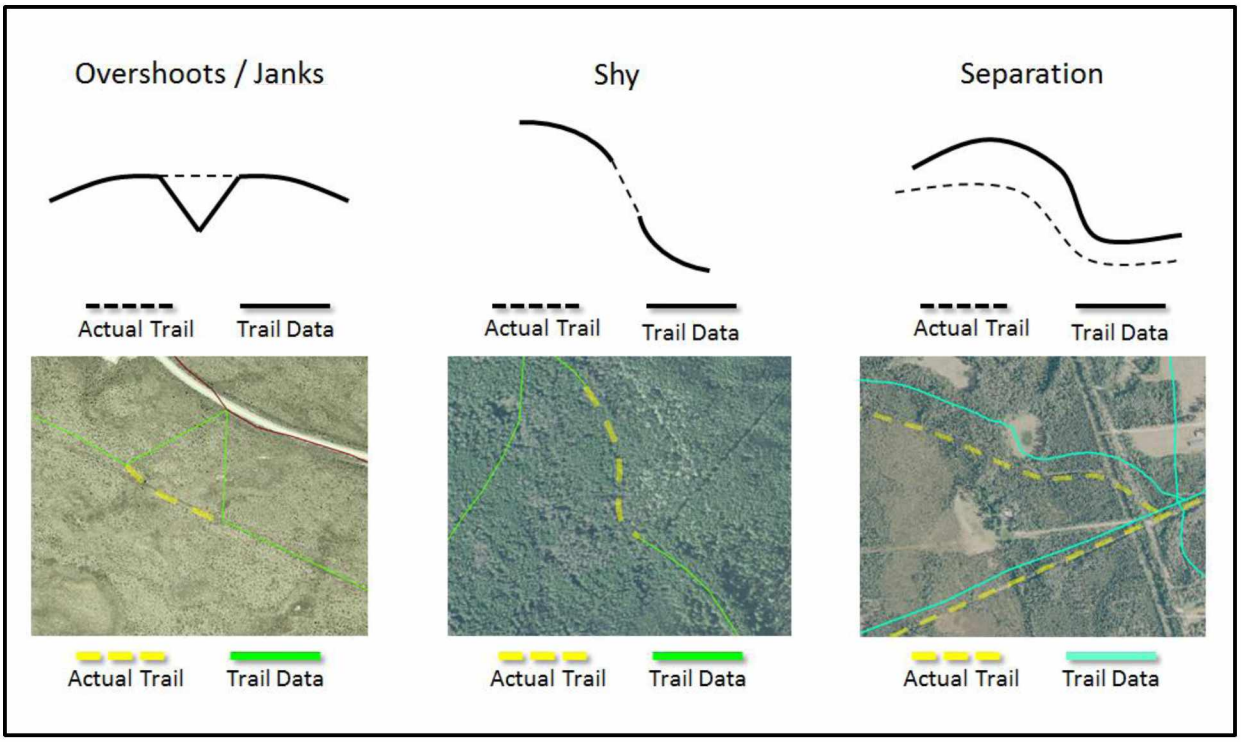


Figure 27. Visual illustrations of GIS data errors

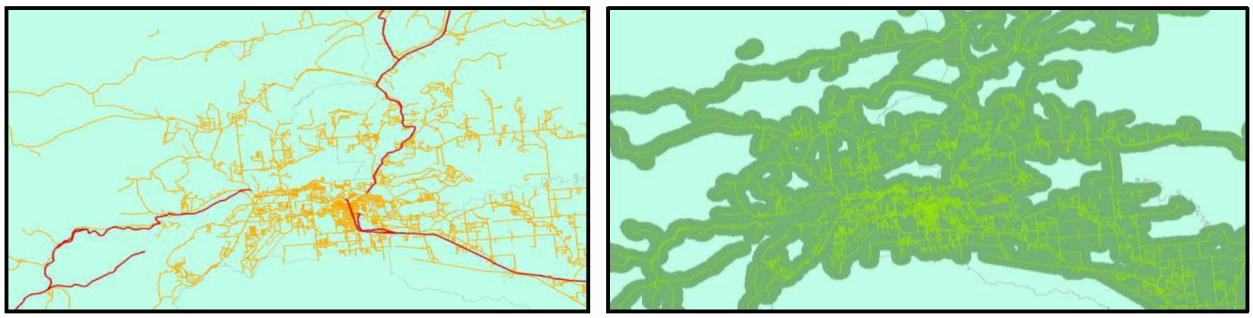
Table 5. Examples of locations with GIS errors and the lengths of those errors

Region Type	Locations	Network Type	Error Type	Avg. Distance (m)
Urban	Fairbanks, Anchorage, Juneau	Road	Overshoots/Janks	106.6
			Shy	87.1
			Separation	1426.9
		Trail	Overshoots/Janks	67.1
			Shy	145.0
			Separation	750.5
Suburban	Healy, Deltana, Mentasta	Road	Overshoots/Janks	139.5
			Shy	629.8
			Separation	230.2
		Trail	Overshoots/Janks	479.1
			Shy	412.2
			Separation	147.8
Rural	Flat, King Salmon, Nikolski	Road	Overshoots/Janks	46.7
			Shy	56.9
			Separation	145.5
		Trail	Overshoots/Janks	288.3
			Shy	95.4
			Separation	271.7

A suite of vector editing tools in ArcMap were used to correct the above errors in the data. This is accomplished by selecting the layer of interest such as highways and the tool of interest such as trim. Then a dangle length needs to be entered. See Table 5 for example dangle lengths i.e. overshoots/ janks. The Extend tool is used for shy type errors and an extend length needs to be entered. The Snap tool helps to correct both the above errors by snapping layers together that are near one another. However, this should be checked to ensure the snapped files are not less accurate than the original files. For Shy errors this can be fixed by moving vector data to line up, but in this case we left them as is because the general lengths and connectivity were the same even if they did not line up perfectly with the satellite imagery. Though several corrective methods were used, the difference between the original vector data and the corrected data was minimal.

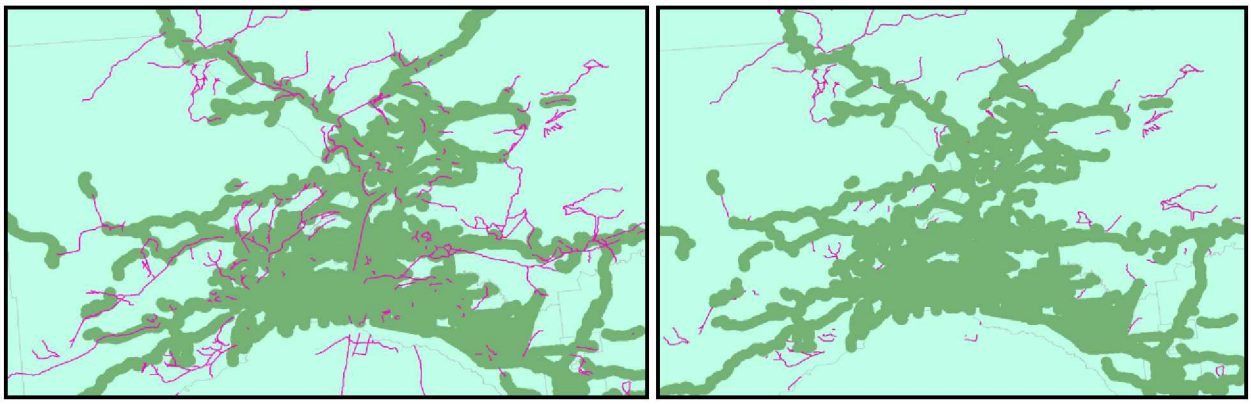
3.3.2 Lengths / Distances

To determine trails that provided additional access (i.e., trails that are not redundant to the road system), the roads and highway layers were merged (Figure 28a). Next, a one-half mile buffer was created around the merged roads/highway layer (Figure 28b). One-half mile was used to differentiate between supplemental and complimentary trail networks as this value is commonly used to represent the distance a person is comfortable with and willing to travel on foot from home to a destination (Yang & Diez-Roux, 2012, Transportation Research Board, 1996). The buffer was used to remove the portion of trails within one-half mile distance from the merged road and highways layer (see Figure 29a and 29b). The buffer was also used to clip trails to one-half mile distance from the merged road and highway layer.



(a) (b)

Figure 28. An example of (a) the roads and highways layers before they have been merged or buffered, and right (b) the merged layers and the 1/2 mile buffer



(a) (b)

Figure 29. An example of (a) trails layer before and (b) after the buffer is used to erase portions within 1/2 mile of roads and highways

The identity tool was used by selecting the trails layer for the input value, and the zip code polygon layer for the identity layer. To determine lengths the add geometry attributes tool was used, and lengths was set to miles. Next, the Spatial Join tool was used on the zip code polygon layer and the trails layer. Unneeded attributes were deleted, and the merge rule was set for lengths to "sum".

3.3.3 Connectivity Factors and Determination

To determine the number and extent of places connected by highways, the Select by Location tool was used to identify places that were intersected by highways was used. A manual spot check was performed by looking over the vector and polygon data to make sure each place intersected by a highway also connected to at least one other place. The same method was repeated for secondary roads, and trails. Once each layer was established the data was moved into Excel to delineate which places were precisely connected by which methods. This was accomplished by looking for repeated places between groups. For example if a places was connected by roads and trails that place would show up in both the connected by roads layer and the connected by trails layer. By using count if and conditional formatting in excel places that are connected by multiple networks can be counted and then place connectivity can be defined more specifically.

3.3.4 Isolation Factors and Determination

After the connected places were identified, these were removed from the parent places file to identify unconnected places. Next, the Select by Location feature was used to determine which places were intersected by highways, roads and trails respectively. A new layer was created for each. The data was then moved into excel to determine overlap and non-overlap in places that had highways, roads, and/or trails. All of the places with highways, roads, and/or trails were then merged. Then the erase function was used to erase all places that had highways, roads, or trails to determine the number of places with no highways, roads, or trails.

3.4 Trauma GIS Location Analysis

Using the "injregion", which specifies the region or city that the trauma took place, the trauma registry data could be connected to the populated places used in the GIS connectivity analysis. By using joins and relates the trauma data was added to the GIS data. Once this was completed the data was exported and organized by mode and level of connectivity. The general categories, of connected and not connected, t-tests were performed for all traumas by mode and then for on-road traumas by mode. Then F-tests were performed for each both all traumas and on-road traumas specified by how the places where the traumas occurred were connected or what transportation networks were available in isolated places where the traumas occurred.

4 RESULTS

The results follow the same pattern of data with the survey results shown first. Second, the Trauma registry data results are reported. Thirdly, the GIS mapping of connectivity is displayed. Lastly, the results of the trauma mapping are reported.

4.1 Survey

A total of 214 people took the survey and indicated they were from Alaska. Of the total 214 total responses only 206 stated a valid Alaskan zip code and so only 206 responses were used. The current density requirements for urbanized areas and urban clusters are 50,000 or more and 2,500 – 50,000, respectively. All areas not classified as urban are classified as rural (U.S. Census Bureau, 2015). Of the 206 valid responses, 57% of respondents resided in a rural area and 43% in an urban area. Of the 57% that reported living in rural areas, 34% live in areas self-reported as edge, 9.7% in gateway areas, 8.3% in remote areas, 2.4% living in main street areas, and 1.5% in resource dependent areas (Figure 30). Definitions for each rural subcategory can be found in Appendix C survey question eight.

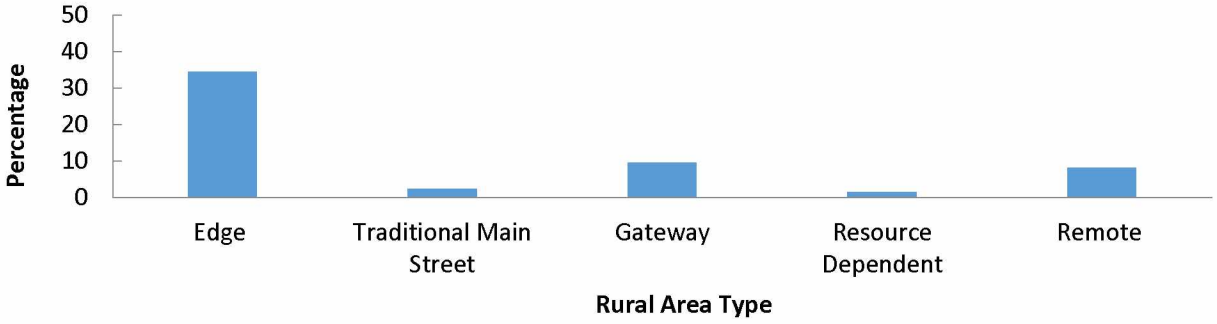


Figure 30. Rural subcategories in Alaska

Additionally, 46% and 53% identified as being male and female, respectively. The age range of respondent's looks normally distributed with a larger variance. The smallest number of respondents identified as age 18-25 with a response percentage of 6.4 (Figure 31). The next lowest number of responses was for respondents that identified as age 26-30 (7.8%). The two groups with the most respondents were age range 31-40 and 41-50 with percentages of 25 and

27.5 respectively. The final two categories age 51-60 and greater than 60 had response percentages of 20.1 and 13.2, respectively.

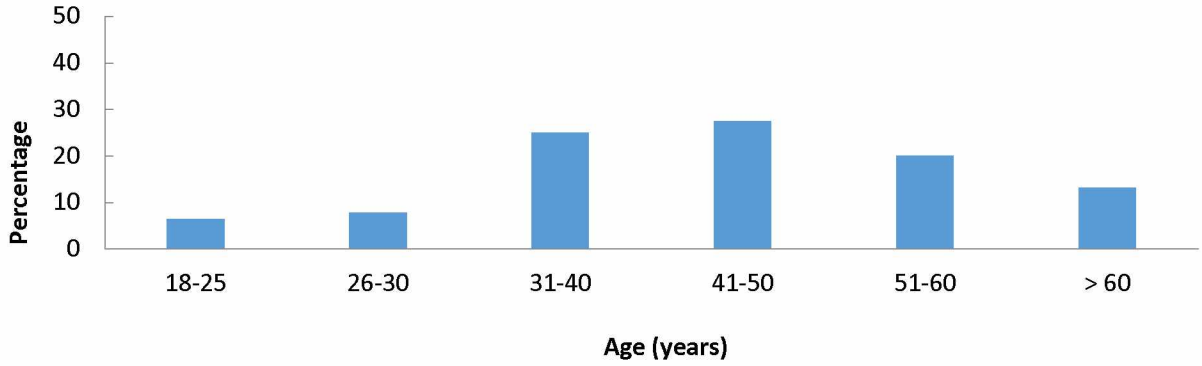


Figure 31. Distribution of age of the respondents

The mode most used for all trip types was the bicycle (Figure 32). The only modes used for grocery shopping were bicycle, ATV, and other. Motorcycles, ATVs, snowmachines, and dog powered modes were most used for fun/entertainment. This is reflected again in Figure 34 with these modes being primarily used for fun/entertainment. Walk was most used for work. This is different from Figure 34 where walk was used primarily for a mixture of recreation and utilitarian purposes. The mode most used for going to work is the bicycle. Only 5% of respondents (Figure 33) used motorcycle (2%), snowmachine (2%), dog powered (1%), or agricultural vehicles (0%).

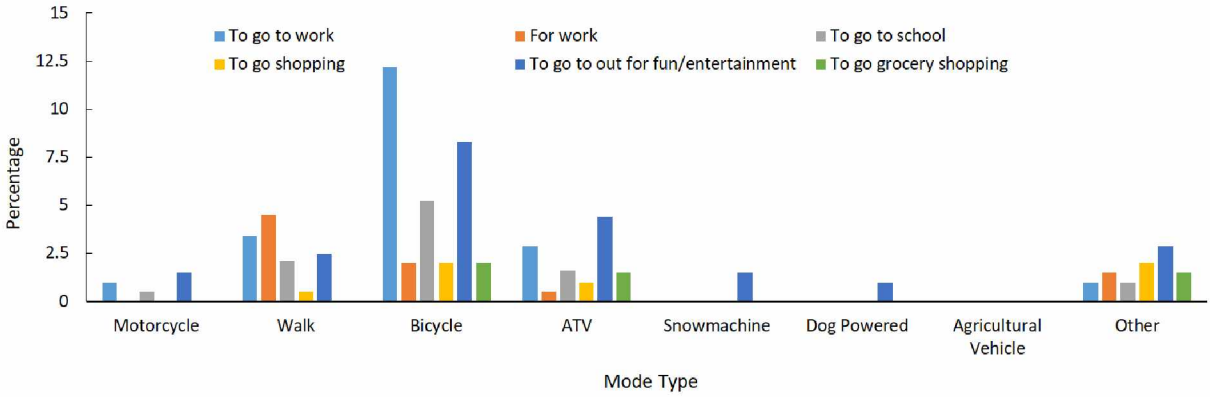


Figure 32. Primary mode use by trip type

Shown in Figure 33 snowmachines (47%), and dog powered (75%) are primarily used for recreation only. AVTs (33%), bicycles (34%), and walking (34%) are mostly used for a mixture of recreation and utilitarian purposes.

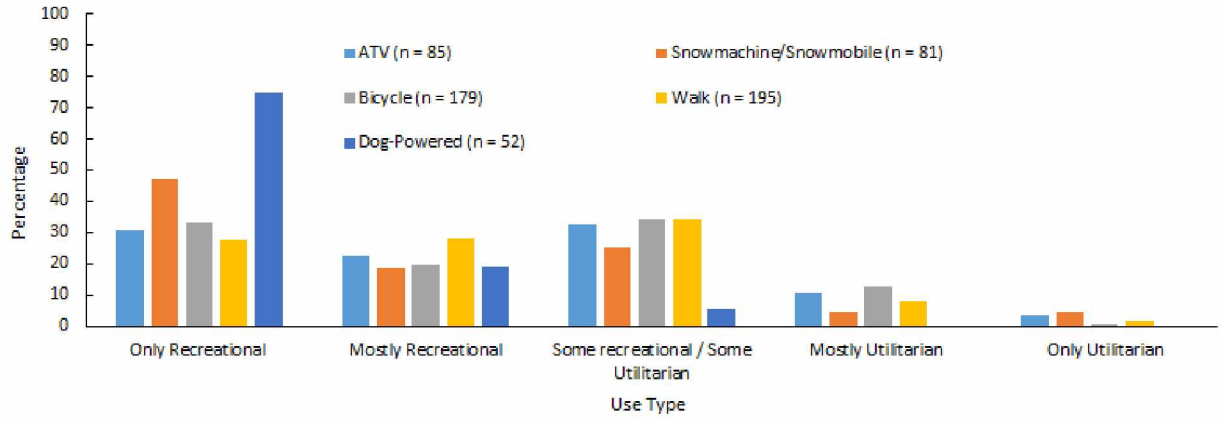


Figure 33. Use type by mode

Shown in Figure 34 about 97% of respondents drive an automobile on or near roadways. Pedestrians and cyclist survey respondents operate on or near the roadway 89% and 73% of the time respectively. Survey respondents use ATV, snowmachines, and dog-powered modes on or near roadways 24%, 23%, and 19% of the time, respectively.

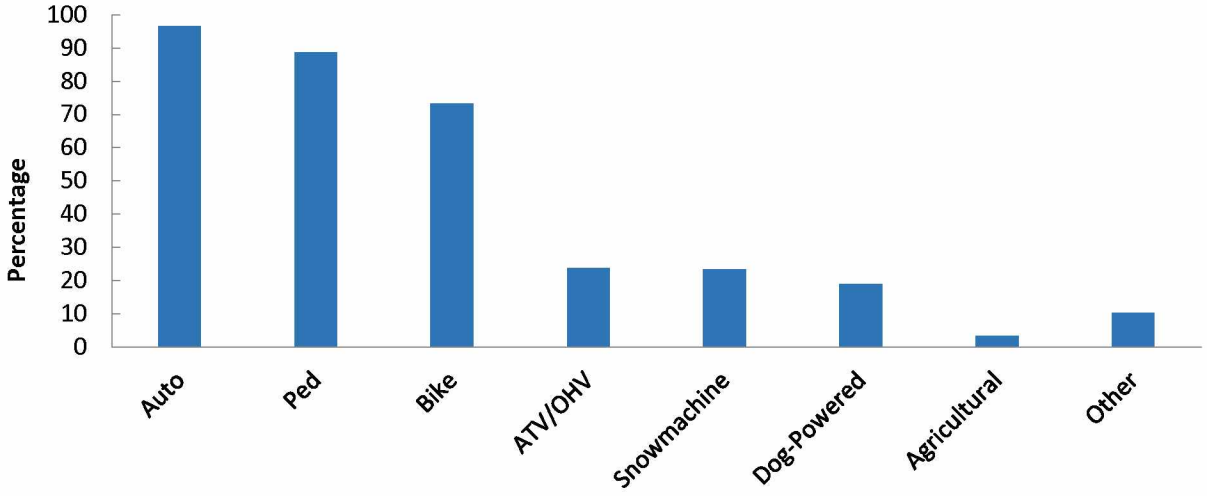


Figure 34. Percentage of mode use on or near roadways

Figure 35a through Figure 35c show an increase in usage of non-traditional and non-motorized transportation modes as the road type shifts from multilane highway to two-lane road (i.e., as the facility type reduces in size). A similar trend is seen in Figure 35d through Figure 35f as the infrastructure type moves farther from the traveled way (i.e., on the road to an adjacent or non-road path/trail).

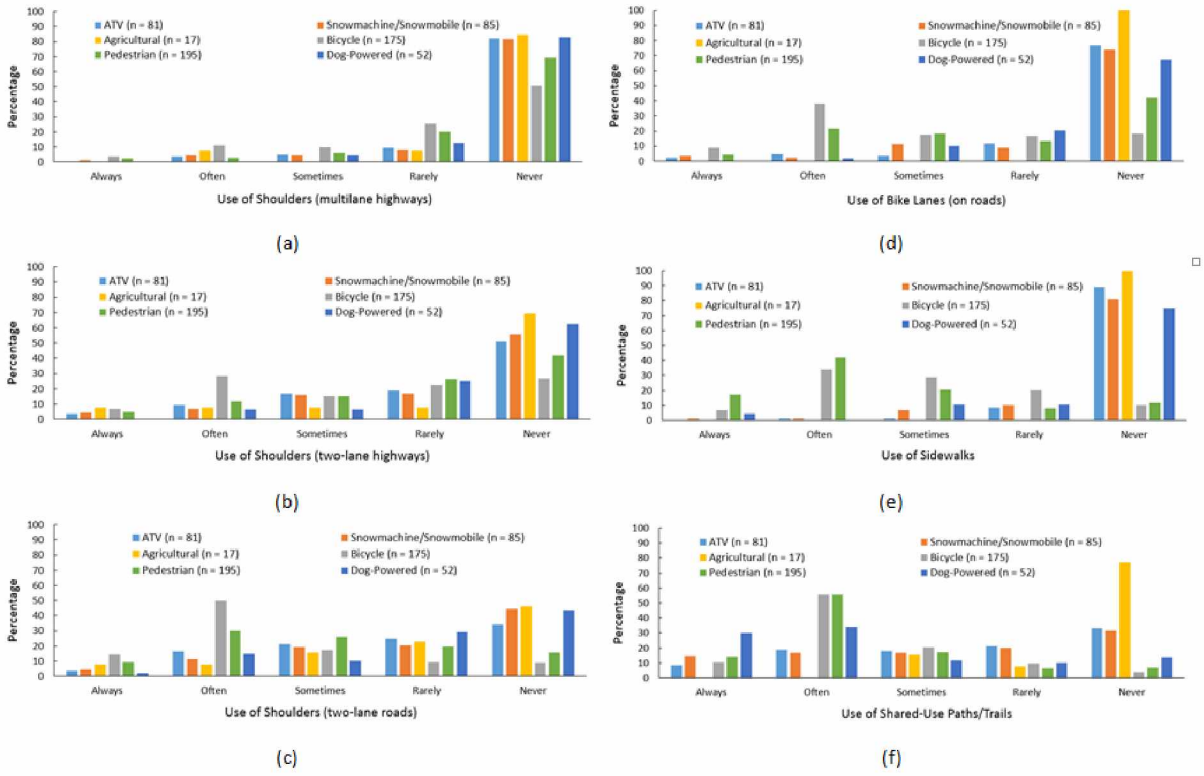


Figure 35. Modal use of shoulders on (a) multilane highways, (b) two-lane highways, (c) two-lane roads and of (d) bike lanes, (e) sidewalks, and (f) shared-use paths/trails

Roughly 53% of ATV users agree that there are adequate trail opportunities near their homes (see Figure 36). This is comparable with responses from snowmachine users at approximately 53 percent.

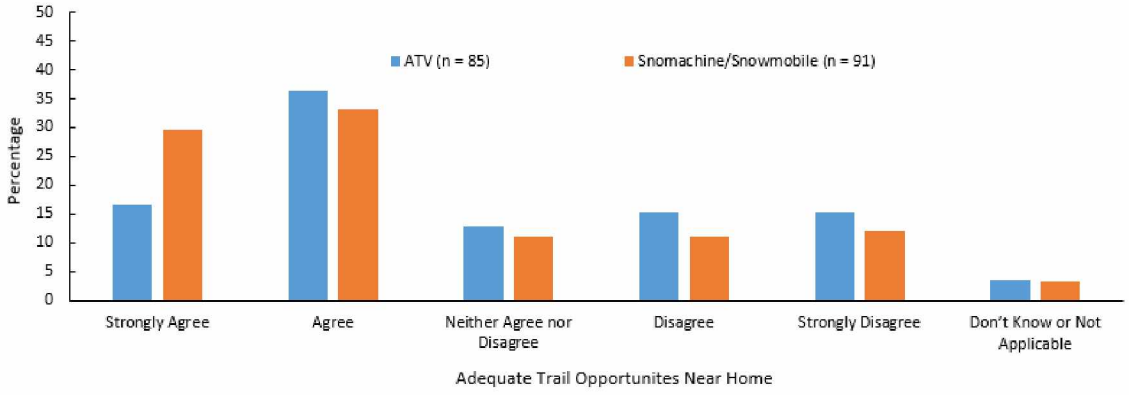


Figure 36. Perceived access to trail opportunities of ATV and snowmachine users

The highest frequencies of ATV and snowmachine ownership to automobile ownership ratios are for a one to one relationship at 28% and 33% respectively (Figure 37). The next two highest categories are one to two or 0.5, and four to six or 0.67. The percentages of these ratios are 14% and 11% respectively for ATVs, and 15% and 16% respectively for snowmachines.

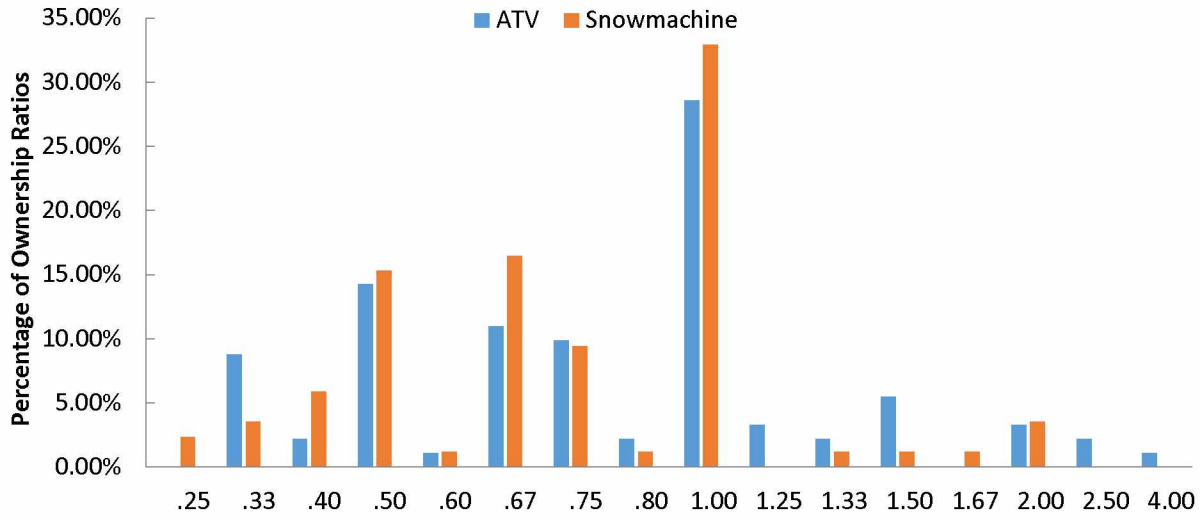


Figure 37. Ratio of ATV & Snowmachine ownership to Automobile ownership

Figure 38 illustrates that the majority of respondent households stated that they have two people that use ATVs (55%) or snowmachines (48%). The next largest category is that of households that reported only having one user 21% for ATVs and 26% for snowmachines. For households with three or more users the percentage gets progressively lower.

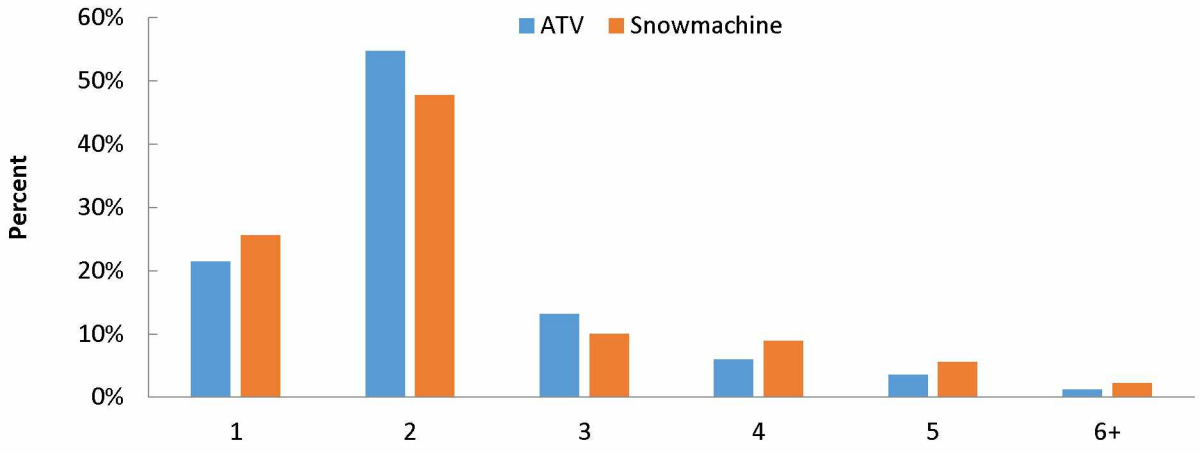


Figure 38. Number of individuals in a household that use ATVs or Snowmachines

The percentage of respondents that selected the number of miles they put on both ATVs and Snowmachines has almost a log normal distribution until the greater than 1000 mile category (Figure 39). Approximately 32% of ATV users and 36% of snowmachine users put less than 100 miles on their machine per year. Approximately 35% of ATV users and 25% of snowmachine

users put less than 100 miles on their machine per year. Only about 5% of ATV users and 11% of snowmachine users put between 501 and 1000 miles on their machine per year. Lastly, about 10% of ATV users and 17% of snowmachine users put more than a thousand miles on their machines per year.

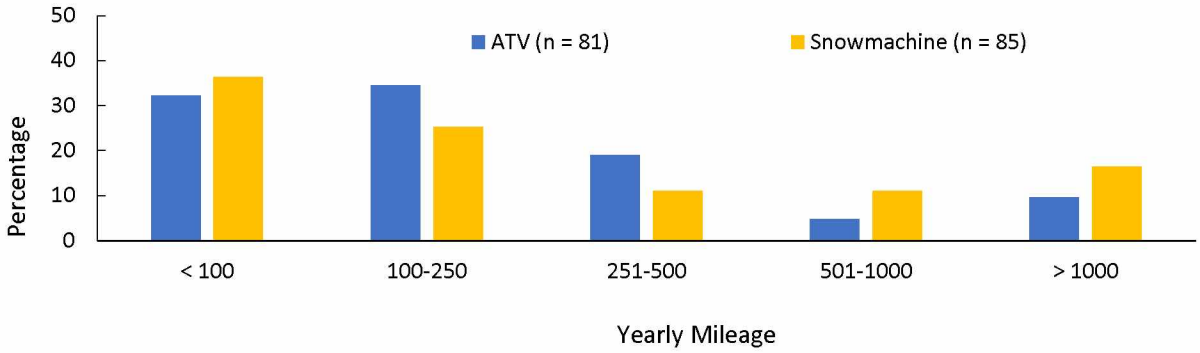


Figure 39. Average yearly miles traveled by ATVs and snowmachines

4.1.1 Accessibility

Table 6 reports the frequency counts for the questions "I feel that there are adequate trail opportunities to ride my ATV near my home" and "In which one of the following areas do you consider your current home to be". The correlation coefficient is 0.333 which is a positive value so there is a positive correlation between rural and urban with respect to the statement: I feel that there are adequate trail opportunities to ride my ATV near my home. The correlation coefficient is not close to one however, so there is not a strong correlation. The original assumption was that these two variable were correlated this offers evidence supporting that assumption. Correlation is only defined for quantitative variable, so SPSS is assuming numerical scores for the rural versus urban variable and those scores are arbitrary.

Table 6. Perceived trail access by residential setting

		I feel that there are adequate trail opportunities to ride my ATV near my home.					
		Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Don't Know or Not Applicable
In which one of the following areas do you consider your current home to be?	Rural	10	25	9	8	5	2
	Urban	4	6	2	5	8	1

Variable A: Rural vs. Urban

Variable B: Adequate Trail Opportunities for ATVs

$$H_o: Variable\ A\ and\ Variable\ B\ are\ independent.$$

$$H_a: Variable\ A\ and\ Variable\ B\ are\ not\ independent.$$

The test statistic is the independence of the variables. The rejection criteria for this test is that the p-value is less than α (α = 0.05).

Table 7. Output of the Chi Squared Test of independence

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.922[a]	5	0.112
Likelihood Ratio	8.570	5	0.128
Linear-by-Linear Association	4.682	1	0.030
N of Valid Cases	85		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .92.

Based on the Pearson chi-square value of 8.922 and the p-value of 0.112, which is greater than α = 0.05, there is not a statistically significant association between residential location (i.e. rural or urban) and a person's perception of having adequate access to ATV trails near their home. In this case, we fail to reject H_o (Table 7). However, since 50% of the cells have a value of less than 5 the one of the assumption for the chi squared test is violated so the likelihood ratio value and associated p-value are used instead. The likelihood ratio value is 8.57, and the associated p-value is 0.128. The previous conclusion holds and we fail to reject H_o meaning that a respondent's perceived access to trails is independent of whether they live in a rural or urban area.

4.1.2 Safety

Respondents for all modes use fluorescent or reflective clothing and lights on self or belongings as safety features (Figure 40). Dog-powered has the highest percentages of both with 71% and 82% respectively. Bicycles are the only mode that uses headlights or taillights and about 50% of cyclists use them.

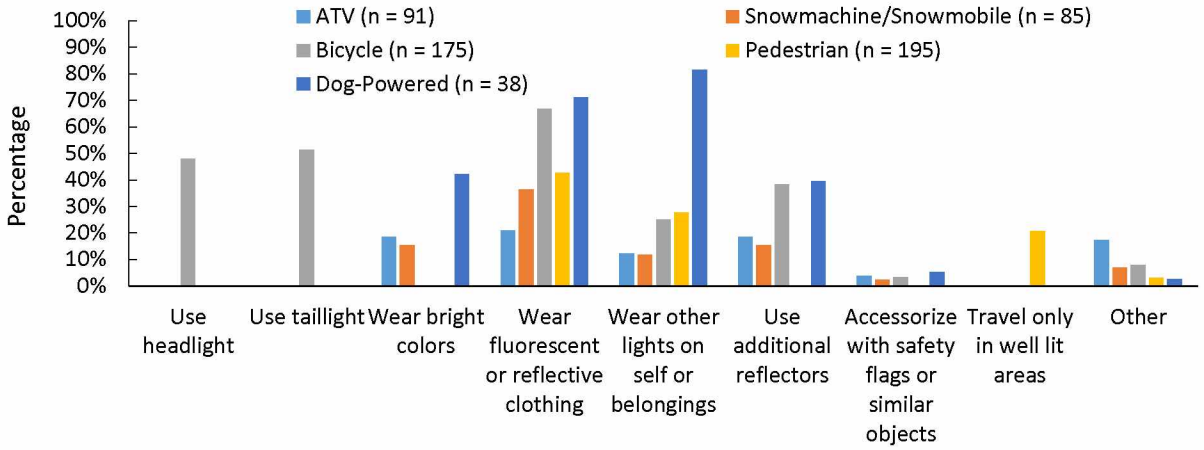


Figure 40. Types of safety features used by each mode

Respondents that use dog-powered modes selected that they never wear a helmet 77% of the time (Figure 41). Whereas respondents that use snowmachines and bicycles selected that they always wear a helmet 58% and 57% of the time respectively. ATV users are fairly consistent across all usages, but have higher percentages for always (24%) and never (29%).

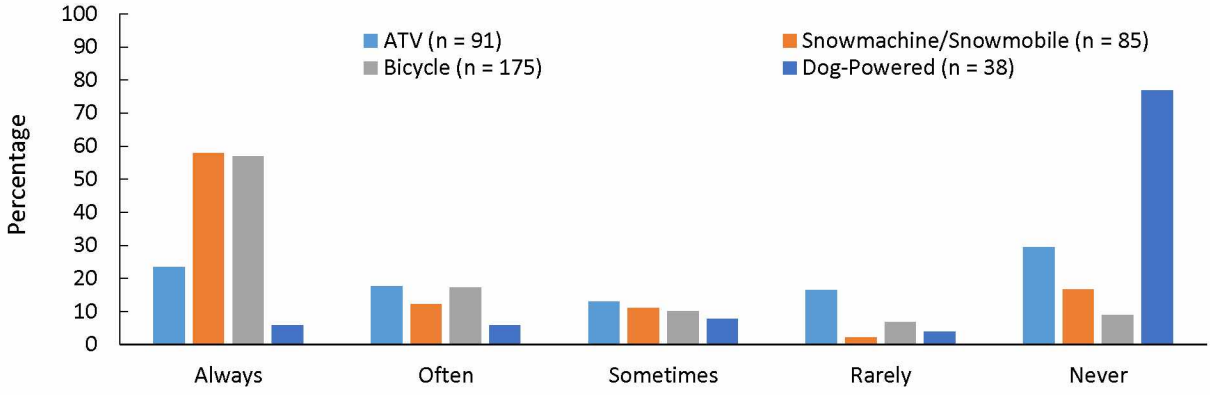


Figure 41. Helmet use by transportation mode

Table 8 reports the frequency of occurrence values for the questions, "what is your one-way commute distance to the nearest town center" and "Does riding an ATV in mixed traffic seem to reduce your safety". Since correlation can only be done between two values yes and no answers were selected for the following question: Does riding an ATV in mixed traffic seem to reduce your safety? The correlation coefficient value is positive so there is a positive correlation

between the answers yes and no with respect to the question: What is your ONE-WAY commute distance to the nearest town center? The correlation coefficient is 0.916 which is positive and close to one, so there is a strong positive correlation. Since the original assumption was that these two variables were not correlated this offers evidence to the contrary. Correlation is only defined for quantitative variable, so SPSS is assuming numerical scores for the rural versus urban variable and those scores are arbitrary.

Variable A: Safety Perception Mixed Traffic

Variable B: Proximity to Town Center

$$H_o: Variable\ A\ and\ Variable\ B\ are\ independent.$$

$$H_a: Variable\ A\ and\ Variable\ B\ are\ not\ independent.$$

The test statistic is independence of the variables, and the rejection criteria is a p-value less than α ($\alpha = 0.05$).

Table 8. Output of the Chi Squared Test of independence

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10.416[a]	10	0.405
Likelihood Ratio	10.721	10	0.380
Linear-by-Linear Association	0.038	1	0.845
N of Valid Cases	84		

a. 12 cells (66.7%) have expected count less than 5. The minimum expected count is .55.

More than 20% of the cells have expected count less than 5, so one of the assumptions for the chi-squared test is violated. Using the likelihood ration value of 10.721, and the associated p-value of 0.380 which is greater than α ($\alpha = 0.05$), so there is not a statistically significant association between safety perception in mixed traffic and the distance from which a respondent lives from the nearest town center (Table 8). In this case we fail to reject H_o indicating that a respondent's proximity to a town center does not impact their perception of safety in mixed-use traffic.

4.1.3 Modeling

Once the data was recoded a linear forward pass model selection was used to reduce the number of variables for modeling. This is because the cumulative logit model requires that the model have much fewer predictors than data points. By using the linear forward pass to eliminate variables that were unlikely to be significant it saved a lot of time when running the various cumulative logit models. The forward pass is a statistical tool often used to pare down variables for modeling and the SPSS software only does a forward stepwise model selection for linear models not generalized linear models.

The final model selected by the linear forward pass for ATVs included two variables. The survey question, "How do you typically access those trails?" and survey question, "On average, how many miles do you ride your ATV in a year?" as seen in Table 9.

Table 9. ANOVA table for the Linear Forward Pass on the ATV variables

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
How do you typically access those trails?	Regression	11.290	1	11.290	8.509	0.006
	Residual	46.440	35	1.327		
	Total	57.730	36			
On average, how many miles do you ride an ATV in a year?	Regression	17.172	2	8.586	7.198	0.002
	Residual	40.557	34	1.193		
	Total	57.730	36			

a. Dependent Variable: I feel that there are adequate trail opportunities to ride my ATV near my home.

Once the forward pass was completed a cumulative logit model test could be performed using the selected variables. In addition to testing the "base model" selected by the forward pass; six other variables were tested using the cumulative logit model. These variables were selected in part due to preliminary variable and cross tabulation testing but also by looking at the model from an engineering perspective and selecting variables that could logically have an impact on a respondent's access to trails near their home.

I. **Q7** - In which one of the following areas do you consider your current home to be?
II. **Q9** - How many of each transportation mode listed below does your household own?
    a. Recoded to a ratio of ATV ownership to automobile ownership
III. **Q17** - How frequently do you ride an ATV on, adjacent to, or near a roadway?
IV. **Q29** - How many individuals, including yourself, ride an ATV in your household?
V. **Q31** - On average, how many miles do you put on your ATV in a year?
VI. **Q39** - Why do you most commonly ride an ATV? Select all that apply.

A cumulative logit model was fit on the base model and then the base model plus one of the additional variables. The resulting AIC and corrected AIC values were compared to determine the best fitting model Table 10. The base model has the lowest AIC value therefore it is the best fitted model. In the case processing summary (Table 11) one of the 85 cases was excluded. This is likely due to there being a null/ missing value in the data, or it was an outlier value.

Table 10. AIC and corrected AIC values from the ATV Cumulative Logit Model

Model Number	Model Name	AIC	Corrected AIC
1	Base model	119.784	121.704
2	Base + Q7	147.608	150.041
3	Base + Q9	194.915	197.487
4	Base + Q17	167.255	170.921
5	Base + Q29	188.494	190.926
6	Base + Q32	163.781	166.246
7	Base + Q39	197.560	208.083

Table 11. The case processing summary from the ATV Cumulative Logit Model output

Case Processing Summary		
	N	Percent
Included	84	98.8%
Excluded	1	1.2%
Total	85	100.0%

Below in Table 12 are the tests of model effects for the ATV cumulative logit model. Looking at the tests of model effects both Q37 and Q31 are significant predictors in the model.

Table 12. Model effects for the ATV Cumulative Logit Model

Tests of Model Effects								
Q#	Source	Type III						
		Likelihood Ratio Chi-Square	df	Sig.	F	df1	df2	Sig.
Q37	How do you typically access those trails?	17.013	2	0.000	8.506	2	67	0.001
Q31	On average, how many miles do you ride an ATV in a year?	9.351	1	0.002	9.351	1	67	0.003
Dependent Variable: I feel that there are adequate trail opportunities to ride my ATV near my home.								

Table 13. Parameter estimates for the ATV Cumulative Logit Model

Parameter Estimates				
	Parameter	B (log odds ratio)	Odds Ratio	Std. Error
Threshold	[I feel that there are adequate trail opportunities to ride my ATV near my home.= Strongly Agree]	-3.770	0.023	0.5559
	[I feel that there are adequate trail opportunities to ride my ATV near my home.= Agree]	-1.658	0.191	0.4330
	[I feel that there are adequate trail opportunities to ride my ATV near my home.= Neither Agree nor Disagree]	-1.020	0.361	0.4188
	[I feel that there are adequate trail opportunities to ride my ATV near my home.= Disagree]	-0.069	0.933	0.4245
	[I feel that there are adequate trail opportunities to ride my ATV near my home.= Strongly Disagree]	1.852	6.370	0.6140
[How do you typically access those trails?= No access to trails]		0.809	2.246	1.0789
[How do you typically access those trails?= Ride from Home]		-1.455	0.233	0.3950
[How do you typically access those trails?= Haul with Trailer]		0[a]	1.000	
On average, how many miles do you ride an ATV in a year?		-0.443	0.642	0.1482
(Scale)		.792[b]	2.208	

Dependent Variable: I feel that there are adequate trail opportunities to ride my ATV near my home.
Model: (Threshold), How do you typically access those trails?, On average, how many miles do you ride an ATV in a year?
a. Set to zero because this parameter is redundant.
b. Computed based on the deviance.

Table 13 reports the parameter estimates for the ATV cumulative logit model. Based on the values above the odds of a person who does not have access to trails agreeing that they have adequate access to trails is 2.25 times that of a person who hauls their ATV to a trail head with a trailer. The odds of a person who rides from home agreeing that they have adequate access to trails is 0.233 times that of a person who hauls their ATV to the trail head with a trailer. This means that a person who hauls their ATV with a trailer is much more likely to agree that they have adequate access to trails than a person who rides from home. Lastly, the odds that a person agrees that they have adequate access are smaller for people who ride more miles per year.

The cross tabulated values for predicted category value and the response variable that asks respondents if they have adequate access to trails can be used to assess the prediction accuracy of the model (Table 14). Of the respondents that selected strongly agree 5 out of 14 were predicted correctly. Of the respondents that selected agree 27 out of 31 were predicted correctly. Lastly, of the respondents that selected strongly disagree 4 out of 12 were predicted correctly. The total predictive accuracy of the model is the ratio of correct predictions (36) to total values (84) giving a 43% model predictive accuracy.

Table 14. Cross tabulation of the predicted category value and the response variable showing prediction accuracy of the ATV model

Cross Tabulation								
		I feel that there are adequate trail opportunities to ride my ATV near my home.						Total
		Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Don't Know or Not Applicable	
Predicted Category Value	Strongly Agree	5	1	0	0	1	0	7
	Agree	8	27	8	11	7	1	62
	Strongly Disagree	1	3	3	2	4	2	15
Total		14	31	11	13	12	3	84

For snowmachines there was an indication of quasi-complete separation in the response variable. To rectify this issue the categories strongly agree and agree were collapsed into one category "agree". Likewise, the categories disagree and strongly disagree were collapsed into the single category disagree. This helped to lower the large standard error to a more reasonable level. The final model selected by the linear forward pass for snowmachines included four variables. The survey question, "How far do you travel to reach opportunities to ride snowmachines?", "What age range describes you?", "What is your marital status?", and "On the shoulders of two lane roads (paved) as seen in Table 15.

Table 15. ANOVA table for the Linear Forward Pass on the snowmachine variables

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
How far do you travel to reach opportunities to ride snowmachines?	Regression	6.676	1	6.676	11.842	.001[b]
	Residual	24.803	44	0.564		
	Total	31.478	45			
What age range describes you?	Regression	10.096	2	5.048	10.152	.000[c]
	Residual	21.382	43	0.497		
	Total	31.478	45			
What is your marital status?	Regression	12.158	3	4.053	8.810	.000[d]
	Residual	19.320	42	0.460		
	Total	31.478	45			
On the shoulders of two lane roads (paved)	Regression	14.327	4	3.582	8.562	.000[e]
	Residual	17.151	41	0.418		
	Total	31.478	45			

a. Dependent Variable: I feel there are adequate trail opportunities to ride my Snowmachine near my home (3 variable version)

b. Predictors: (Constant), How far do you travel to reach opportunities to ride snowmachines?

c. Predictors: (Constant), How far do you travel to reach opportunities to ride snowmachines?, What age range describes you?

d. Predictors: (Constant), How far do you travel to reach opportunities to ride snowmachines?, What age range describes you?, What is your marital status?

e. Predictors: (Constant), How far do you travel to reach opportunities to ride snowmachines?, What age range describes you?, What is your marital status?, On the shoulders of two lane roads (paved)

Once the forward pass was completed a cumulative logit model could be fit using the selected variables. In addition to testing the "base model" selected by the forward pass six other variables were tested using the cumulative logit model. Again, these variables were selected in part due to preliminary variable and cross tabulation testing but also by looking at the model from an engineering perspective and selecting variables that could logically have an impact on a respondent's access to trails near their home.

I. **Q7** - In which one of the following areas do you consider your current home to be?
II. **Q9** - How many of each transportation mode listed below does your household own?
    a. Recoded to a ratio of snowmachine ownership to automobile ownership
III. **Q18** - How frequently do you ride a snowmachine on, adjacent to, or near a roadway?
IV. **Q55** - How many individuals, including yourself, ride a snowmachine in your household?
V. **Q57** - On average, how many miles do you put on your snowmachine in a year?
VI. **Q65** - Why do you most commonly ride a snowmachine? Select all that apply.

A cumulative logit model was fit on the base model and then the base model plus one of the additional variables. The resulting AIC and corrected AIC values were compared to determine

the best fitting model Table 16. The base model has the lowest AIC value therefore it is the best fitted model. In the case processing summary (Table 17) two of the 7 cases were excluded. This is likely due to there being a null/ missing value in the data, or an outlier value or two.

Table 16. AIC and corrected AIC values from the snowmachine Cumulative Logit Model

Model Number	Model Name	AIC	Corrected AIC
1	Base model	108.676	111.690
2	Base + Q7	115.089	118.755
3	Base + Q9	116.420	120.192
4	Base + Q18	108.493	113.693
5	Base + Q55	117.094	120.761
6	Base + Q58	117.803	121.469
7	Base + Q65	110.320	122.195

Table 17. The case processing summary from the snowmachine Cumulative Logit Model output

Case Processing Summary		
	N	Percent
Included	84	92.3%
Excluded	7	7.7%
Total	91	100.0%

Table 18 reports the tests of model effects for the ATV cumulative logit model. Looking at the tests of model effects all four variables: Q64, Q60, Q199, and Q201 are significant predictors in the model.

Table 18. The test of model effects for the snowmachine Cumulative Logit Model

Tests of Model Effects							
Source	Type III						
	Likelihood Ratio Chi-Square	df	Sig.	F	df1	df2	Sig.
On the shoulders of two lane roads (paved)	16.080	4	0.003	4.020	4	112	0.004
What is your marital status?	6.877	2	0.032	3.439	2	112	0.036
How far do you travel to reach opportunities to ride snowmachines?	37.934	1	0.000	37.934	1	112	0.000
What age range describes you?	12.532	1	0.000	12.532	1	112	0.001
Dependent Variable: I feel there are adequate trail opportunities to ride my Snowmachine near my home Model: (Threshold), On the shoulders of two lane roads (paved), What is your marital status?, How far do you travel to reach opportunities to ride snowmachines?, What age range describes you?							

Table 19. Parameter estimates for the snowmachine Cumulative Logit Model

Parameter Estimates				
	Parameter	**B (log odds ratio)**	**Odds Ratio**	**Std. Error**
Threshold	[I feel there are adequate trail opportunities to ride my Snowmachine near my home (3 variable version)= Agree]	4.917	136.542	1.4247
	[I feel there are adequate trail opportunities to ride my Snowmachine near my home (3 variable version)= Neither]	5.675	291.590	1.4630
[On the shoulders of two lane roads (paved)= Always]		1.977	7.220	1.1853
[On the shoulders of two lane roads (paved)= Often]		3.172	23.853	0.8824
[On the shoulders of two lane roads (paved)= Sometimes]		-0.515	0.598	0.6383
[On the shoulders of two lane roads (paved)= Rarely]		0.186	1.205	0.6906
[On the shoulders of two lane roads (paved)= Never]		0[a]	1	
[What is your marital status?= Single]		-2.969	0.051	1.2161
[What is your marital status?= Married or with partner]		-2.044	0.130	0.9045
[What is your marital status?= Separated, divorced, or widowed]		0[a]	1	
How far do you travel to reach opportunities to ride snowmachines?		0.984	2.676	0.2026
What age range describes you?		0.660	1.935	0.2000
(Scale)		.706[b]	2.026	

Dependent Variable: I feel there are adequate trail opportunities to ride my Snowmachine near my home
Model: (Threshold), On the shoulders of two lane roads (paved), What is your marital status?, How far do you travel to reach opportunities to ride snowmachines?, What age range describes you?
a. Set to zero because this parameter is redundant.
b. Computed based on the deviance.

Table 19 reports the parameter estimates for the snowmachine cumulative logit model. The odds that a person who always rides on the shoulder of paved two lane roads agrees they have adequate access to trails is 7.22 times the odds of a person never rides on the shoulder of paved two lane roads. The odds that a person who often rides on the shoulder of paved two lane roads agrees they have adequate access to trails is 23.853 times the odds of a person never rides on the shoulder of paved two lane roads. The odds that a person who sometimes rides on the shoulder of paved two lane roads agrees they have adequate access to trails is 0.598 times the odds of a person never rides on the shoulder of paved two lane roads. The odds that a person who rarely rides on the shoulder of paved two lane roads agrees they have adequate access to trails is 1.205 times the odds of a person never rides on the shoulder of paved two lane roads. The odds that a person who is single agrees they have adequate access to trails is 0.051 times the odds of a person who is separated/divorced/ widowed. The odds that a person who is married/ has a partner agrees they have adequate access to trails is 0.13 times the odds of a person who is separated/divorced/ widowed. The odds that a person agrees that they have adequate access to

trails is larger for people who travel farther to reach trail opportunities. The same is true for people that are older in age.

The cross tabulated values for predicted category value and the response variable that asks respondents if they have adequate access to trails can be used to assess the prediction accuracy of the model (Table 20). Of the respondents that selected agree 54 out of 57 were predicted correctly. Of the respondents that selected disagree 14 out of 20 were predicted correctly. The total predictive accuracy of the model is the ratio of correct predictions (68) to total values (86) giving a 79% model predictive accuracy.

Table 20. Cross tabulation of the predicted category value and the response variable showing prediction accuracy of the snowmachine model

Crosstabulation					
		I feel there are adequate trail opportunities to ride my Snowmachine near my home			
		Agree	Neither Agree nor Disagree	Disagree	Total
Predicted Category Value	Agree	54	6	6	66
	Disagree	3	3	14	20
Total		57	9	20	86

4.2 Trauma Registry Data

Motor vehicles have the most traumas with about 2.5 times more traumas than ATVs. ATVs have a total of 1,352 traumas 347 of which occur on or near roads (based on previously defined categories). Both bicycles and pedestrians have higher numbers of traumas for road categories 451 and 417 respectively. The difference is about 20% higher than that of ATVs. Snowmachines have the next highest number of total traumas at 983 with only 172 of those happening on-road categories. Animal powered has the fewest number of total traumas and the road traumas with 113 and 5 respectively (Table 21).

Table 21. Final counts for trauma data categories

		ATV	Snowmachine	Bike	Pedestrian	Animal Powered	Motor Vehicle (Automobile)
Road	Road Name	45	22	34	25	0	309
	Near Road	4	4	9	9	1	6
	Road Type	275	139	368	326	3	2319
	Intersection	12	5	35	46	0	227
	Address	3	0	2	8	1	18
	Mile posting	8	2	3	3	0	99
Other Transport. Infrastructure		11	1	5	4	0	15
River / Water		47	79	2	3	2	8
Rural Non-Road		319	301	7	11	2	22
Arctic Man		0	16	0	1	0	0
Parking Lots		4	1	9	25	0	15
Public Area/ Parks		39	22	24	2	4	7
Path / Trail		42	51	52	8	4	9
Racing / Track		37	12	9	0	1	16
Personal Property		65	24	56	36	27	44
City/ Town		4	7	3	1	0	5
Private/ Commercial Property		20	6	8	21	12	21
Other / Unknown		26	15	23	6	3	123
Blanks		391	276	167	33	53	91
Total Traumas		1352	983	816	568	113	3354

Figure 42 depicts the distribution of traumas by mode for three different road categories. There is a clear trend of roads having more traumas than either highways or intersections. ATVs have the second highest number of road traumas at 345 with automobiles having the highest value for road and all other trauma categories. Snowmachines have the next highest number of road traumas at 186 with bicycles close behind at 168, then pedestrians at 133, and lastly animal powered with 3 road traumas. Second to automobiles pedestrians have the highest number of highway traumas at 26, next are ATVs and bicycles with 17 and 16 traumas respectively. Snowmachines have 11 on highway traumas and animal powered does not have any traumas on highway. Automobiles, pedestrians, and bicycles have the largest numbers of traumas at intersections 118, 23, and 13 respectively. In contrast, the unconventional modes have fewer traumas at intersections.

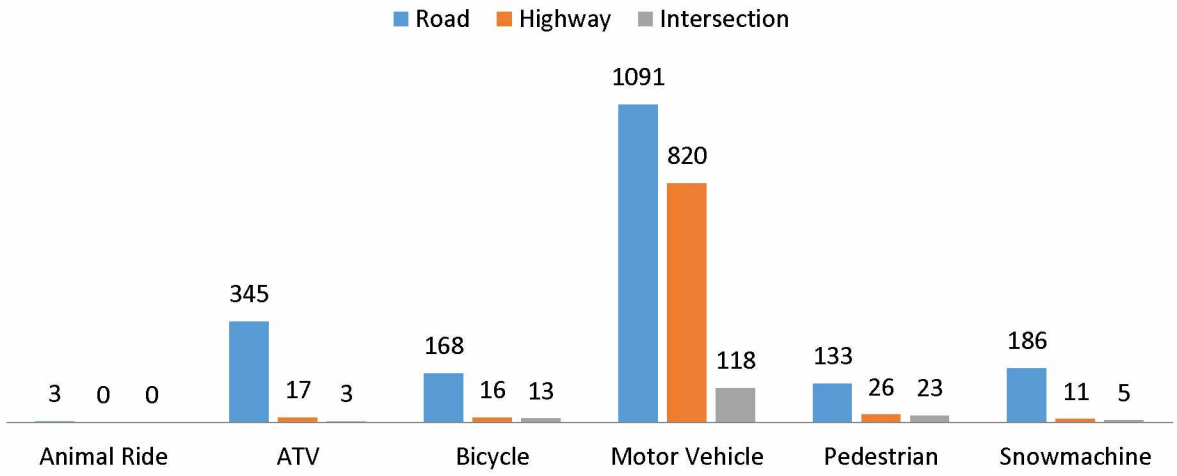


Figure 42. Traumas by mode on roads, highways, and at intersections

4.3 GIS/ Mapping Data

Results of the connectivity analysis indicate that 72 of census populated places are only connected by trail, and 97 places are not connected at all. These findings illustrate the unique transportation environment in Alaska and rural and supplements ongoing research on non-traditional modes of transportation. Future work will seek to define the network structure of trail-connected places as well as the extent to which rivers, particularly during winter months, contribute to these informal networks.

4.3.1 Trail Lengths

The total distance of recorded trails in Alaska is 23,205 miles. Of those 22,350 miles of trails are ½ mile or more from roads and highways. This leaves 855 miles of trails within ½ mile of roads and highways. Figures 43 and 44 depict maps of the trail lengths over the state of Alaska.

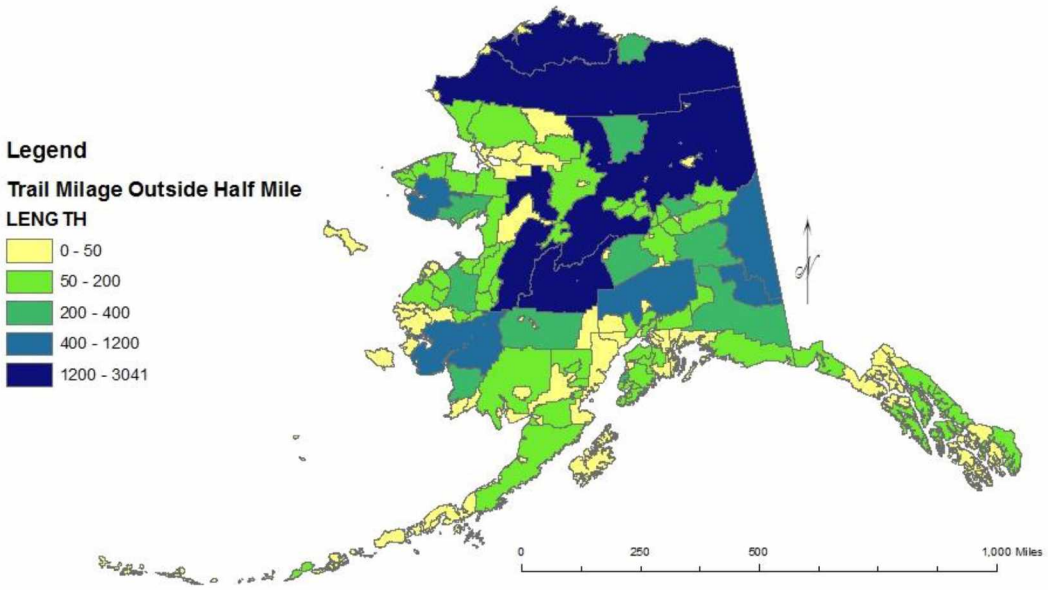


Figure 43. Trail mileage in Alaska supplementary to the road and highway network

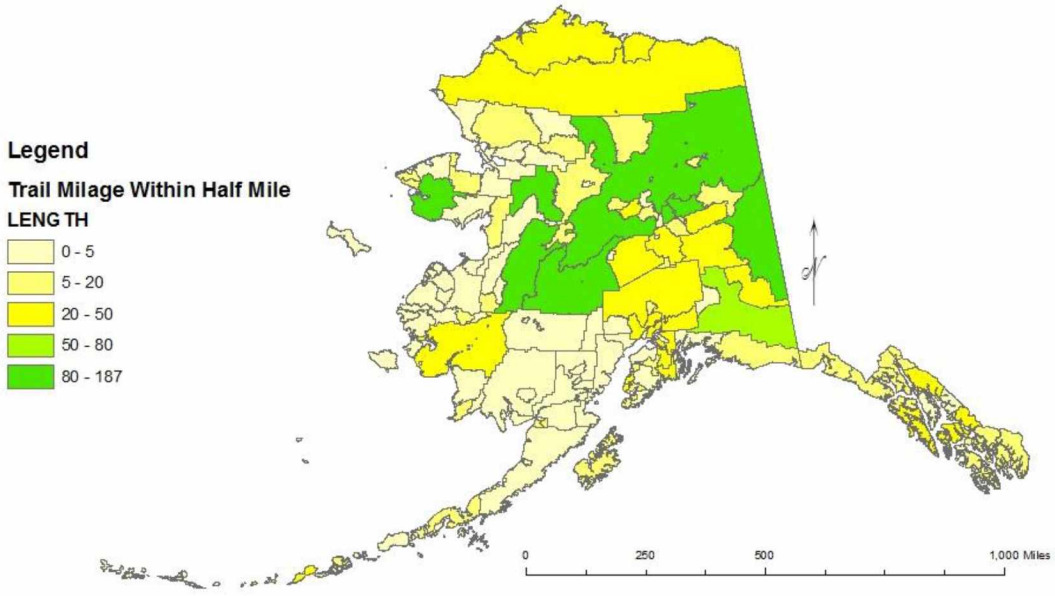


Figure 44. Trail mileage in Alaska complimentary to road and highway network

4.3.2 Connected Places

Of the 355 populated places in Alaska, 258 places are connected to other places by various means. Only 5 places are connected by highways alone. The majority of places are connected via roads and trails (Table 22). Places connected by highways have a lower average percentage of native Alaskans than those connected by roads approximately 8% and 34% respectively (Table 23). As seen in Figure 45 many of the connected places are along the primary road network in Alaska.

Table 22. Characteristics of places that are connected

Type of Network	N	% of Total Places
By highway only	5	1.41%
By highway, and road	24	6.76%
By highway, and trail	1	0.28%
By highway, road and trail	38	10.70%
By roads and trails	55	15.49%
By roads only	63	17.75%
By trails only	72	20.28%
Total	258	72.67%

Table 23. Consolidated list of connectivity types and the number of places that are connected by each network

Type of Network	Number of Places	Average Population	Average Native Population	Percent Native Population
By Highways	32	12,287	981	8%
By Secondary Roads	25	883	302	34%

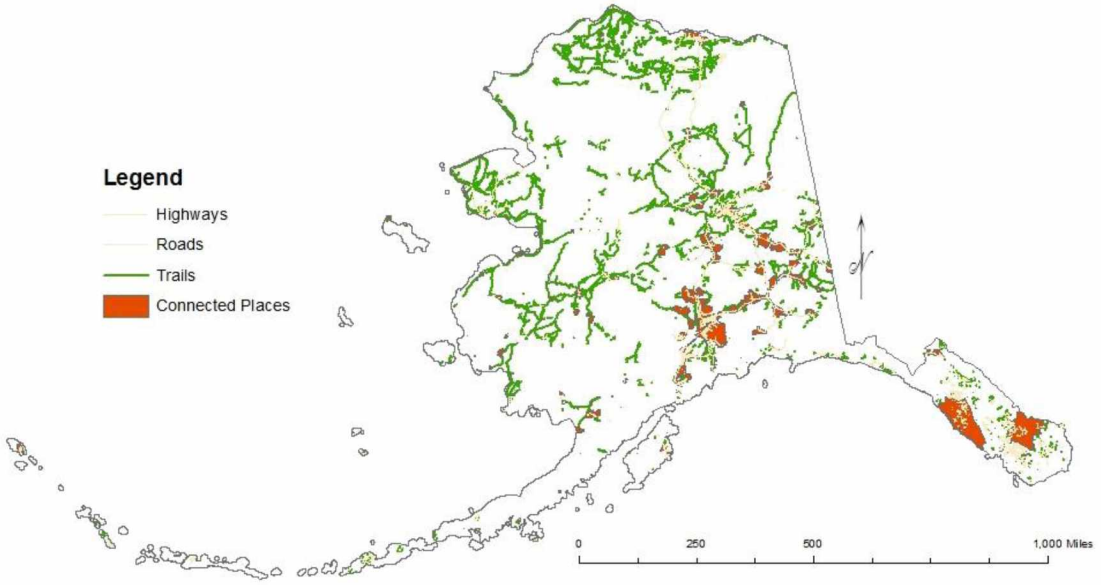


Figure 45. Connected places and highway, secondary road, and trail networks

4.3.3 Isolated Places

Alaska has 97 places that are not connected to any other places by a road, trail, or highway. Only 3 places have all three transportation infrastructure types within the bounds of the polygon (Table 24). As seen in Table 25 the highest average percentages of native Alaskan people can be found in isolated places that either only have trails or do not have any recorded transportation infrastructure. Places that are isolated but have secondary roads have an average of 56% native population, and isolated places with highways have the lowest percentage of natives at 14% on average. As seen in Figure 46 many of these isolated places are not near the primary road network in Alaska. Additionally, these isolated places are not near the trail network either. Almost half of the isolated places do not have any transportation infrastructure at all (Table 24). Figure 47 shows the isolated places that do not have any network data at all.

Table 24. Network characteristics of places in Alaska that are isolated

Network Types	**N**	**% of Total Places**
Have highways, roads, and trails	3	0.85%
Have roads and trails	15	4.23%
Have only roads	18	5.07%
Have only trails	19	5.35%
Have no highway or road or trail data	42	11.83%
Total	97	27.33%

Table 25. Consolidated list of network type in isolated places, the number of places, and the average population numbers

Network Types	Number of Places	Average Population	Average Native Population	Percent Native Population
Have Highways	5	8,677	1,196	14%
Have Secondary Roads	40	742	412	56%
Have trails	17	346	311	90%
Don't have Highway, Road, or Trail Data	16	418	356	85%

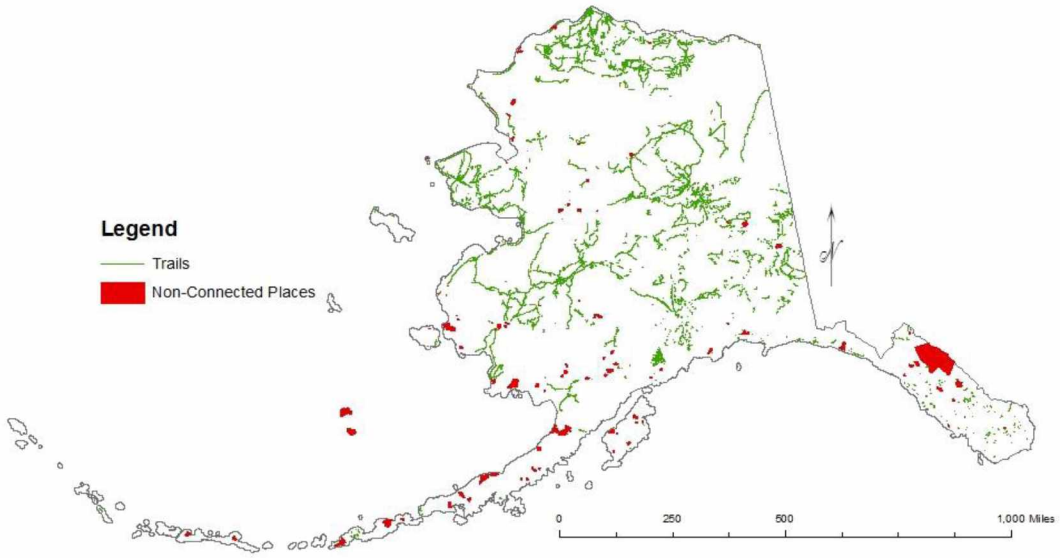


Figure 46. Places that are not connected to other places and trail networks

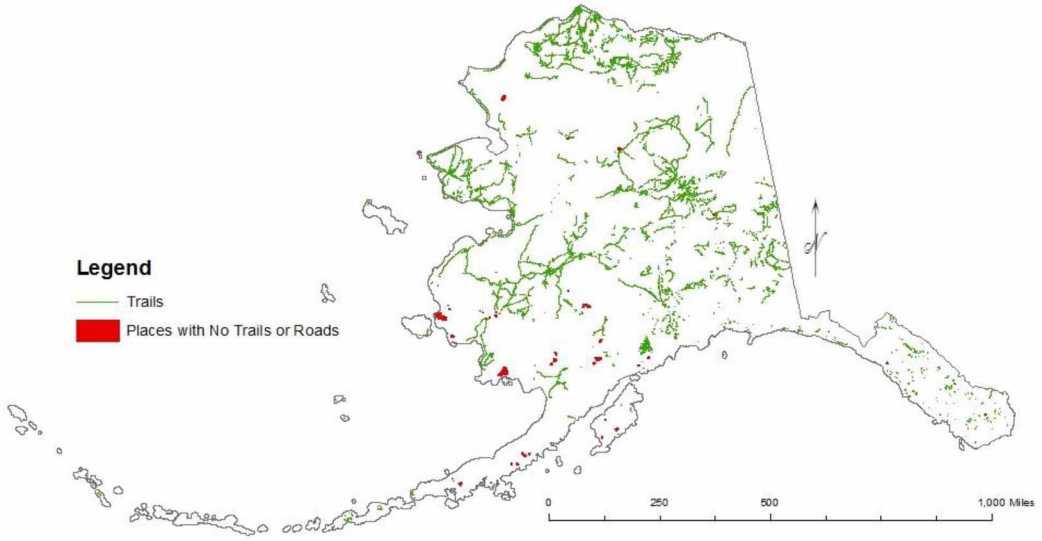


Figure 47. Isolated places that do not have roads, trails, or highways and trail networks

4.4 Trauma GIS Location Analysis

There is a significant difference ($p = 0.012$) in all ATV traumas between connected and not-connected (Table 26). There are more than twice as many ATV traumas on average in connected places than in not-connected places. There is also a significant difference ($p = 0.005$) between connected sub categories for all ATV traumas. Highway connected places have about 3 times as many ATV traumas then secondary road connected places (Table 27). There is also a significant difference ($p = 0.017$) in the number of snowmachine traumas between highway and secondary road connected places. There are roughly 4.5 times as many snowmachine related traumas in highway connected places. For not-connected places the most traumas occur on highways as well, then secondary roads, then trails, and lastly not on-roads at all. The other modes do not have any significant results for all traumas (Tables 26 – 31). For on road traumas, there are no significant results. However, for on-road ATV traumas there is a marginally significant difference ($p = 0.070$) between places connected by highways and places connected by roads (Table 30).

Table 26. Comparative statistics for all trauma data by mode and GIS connected vs. not connected places

Transportation Mode & Trauma Location	Connected		Not-Connected		STAT	
	Mean	Std. Error	Mean	Std. Error	t-test	p-value
All ATV Traumas	7.23	1.492	3.12	0.568	2.576	0.012**
All Snowmachine Traumas	4.18	0.881	2.710	0.689	1.314	0.191
All Bicycle Traumas	8.47	5.060	1.140	0.395	1.445	0.154
All Pedestrian Traumas	6.54	4.560	1.290	0.395	1.147	0.256

** Indicates $p \leq 0.05$

Table 27. Comparative statistics for all trauma data by mode and GIS connected places data by connecting network

Transportation Mode & Trauma Location	Connected						STAT	
	Highway		Secondary Roads		Trails		t-test	p-value
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error		
All ATV Traumas	10.56	2.468	2.96	0.654	No Data		2.978	0.005**
All Snowmachine Traumas	5.91	1.355	1.96	0.855			2.463	0.017**
All Bicycle Traumas	14.44	8.926	0.84	0.423			1.522	0.138
All Pedestrian Traumas	10.59	8.088	1.36	0.712			1.137	0.264

** Indicates $p \leq 0.05$

Table 28. Comparative statistics for all trauma data by mode and GIS not-connected places by available networks within those places

Transportation Mode & Trauma Location	Not-Connected								STAT	
	Highway		Secondary Roads		Trails		None		F-test	p-value
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error		
All ATV Traumas	5.00	2.864	3.55	0.982	2.88	0.766	1.69	0.463	2.227	0.070*
All Snowmachine Traumas	0.80	0.374	3.48	1.260	2.47	0.986	1.63	0.446	0.818	0.516
All Bicycle Traumas	9.00	4.764	0.73	0.280	0.53	0.298	0.38	0.155	0.830	0.509
All Pedestrian Traumas	7.60	4.411	1.20	0.442	0.65	0.209	0.25	0.194	0.548	0.701

* Indicates $0.05 < p \leq 0.1$

Table 29. Comparative statistics for on-road trauma data by mode and GIS connected vs. not connected places

Transportation Mode & Trauma Location	Connected		Not-Connected		STAT	
	Mean	Std. Error	Mean	Std. Error	t-test	p-value
On-Road ATV Traumas	2.28	0.580	1.67	0.394	0.875	0.383
On-Road Snowmachine Traumas	0.81	0.267	1.03	0.388	-0.464	0.643
On-Road Bicycle Traumas	5.81	3.794	0.83	0.322	1.306	0.197
On-Road Pedestrian Traumas	5.16	3.805	0.87	0.297	1.123	0.266

Table 30. Comparative statistics for on-road trauma data by mode and GIS connected places data by connecting network

Transportation Mode & Trauma Location	Connected						STAT	
	Highway		Secondary Roads		Trails		t-test	p-value
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error		
On-Road ATV Traumas	3.19	0.983	1.12	0.307	No Data		2.007	0.052*
On-Road Snowmachine Traumas	1.16	0.414	0.36	0.282			1.589	0.118
On-Road Bicycle Traumas	9.81	6.713	0.68	0.34			1.359	0.184
On-Road Pedestrian Traumas	8.41	6.756	1.00	0.523			1.093	0.283

* Indicates $0.05 < p \leq 0.1$

Table 31. Comparative statistics for on-road trauma data by mode and GIS not-connected places by available networks within those places

Transportation Mode & Trauma Location	Not-Connected								STAT	
	Highway		Secondary Roads		Trails		None		F-test	p-value
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error		
On-Road ATV Traumas	2.20	1.158	1.98	0.710	1.59	0.522	0.81	0.332	0.481	0.750
On-Road Snowmachine Traumas	0.00	0.000	1.28	0.692	1.14	0.697	0.31	0.176	0.584	0.675
On-Road Bicycle Traumas	7.20	4.055	0.50	0.203	0.35	0.191	0.19	0.101	0.724	0.577
On-Road Pedestrian Traumas	5.60	3.415	0.78	0.319	0.35	0.170	0.19	0.136	0.508	0.730

Figures 48 – 51 depict the maps of the significant values from Tables 26 - 31. Figure 47 depicts a map of all ATV traumas that occurred in places that are connected to other places. The map shows the ATV traumas that occurred in places connected by highways (green) and the ATV traumas that occurred in places connected by roads (blue). Traumas that occur in areas connected by secondary roads are spread out in the North Slope, Western Alaska, Bristol Bay, and South East regions of the state while the traumas that occur in places connected by highways mainly occur in the Interior, Cook Inlet, and Prince William Sound areas of Alaska. The traumas that occur in connected areas, especially those connected by highways, are mainly located inland, whereas the traumas that occur in not-connected places (Figure 48) are located along the coastal regions of Alaska. The size of the circles indicates the number of traumas that occurred in a particular place. The larger the circle, the more traumas that have occurred in that location.

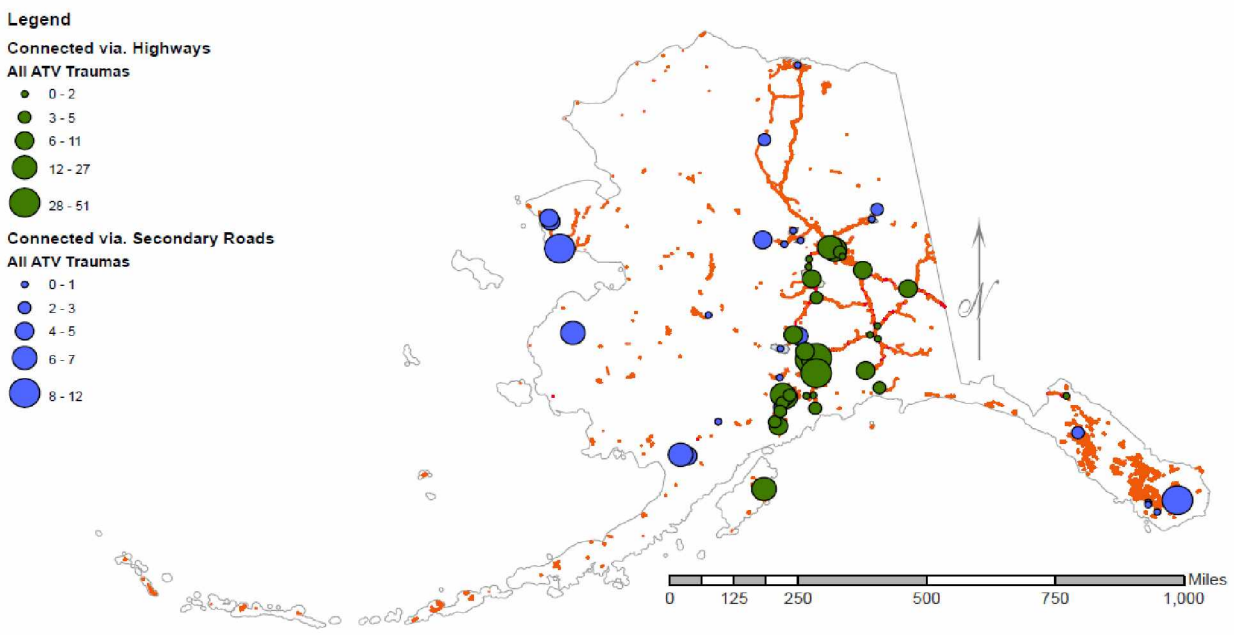


Figure 48. ATV traumas by location and the network which connects these places

Figure 49 depicts a map of all ATV traumas that occurred in places not connected to other places. The map shows the ATV traumas that occurred in places not connected by any transportation network (according to current data). These places may have some transportation network data within their borders even though these networks do not connect to any other places such as places that have highways (red), have roads (orange), have trails (yellow), or have no network data (purple). Again, the size of the circles indicates the number of traumas that occurred in a particular place. The larger the circle the more traumas that have occurred in that location. These traumas are mainly along the coastal areas of Alaska, namely the North Slope, Northwest Arctic, Western Alaska, Bristol Bay, Aleutians, and Southeast.

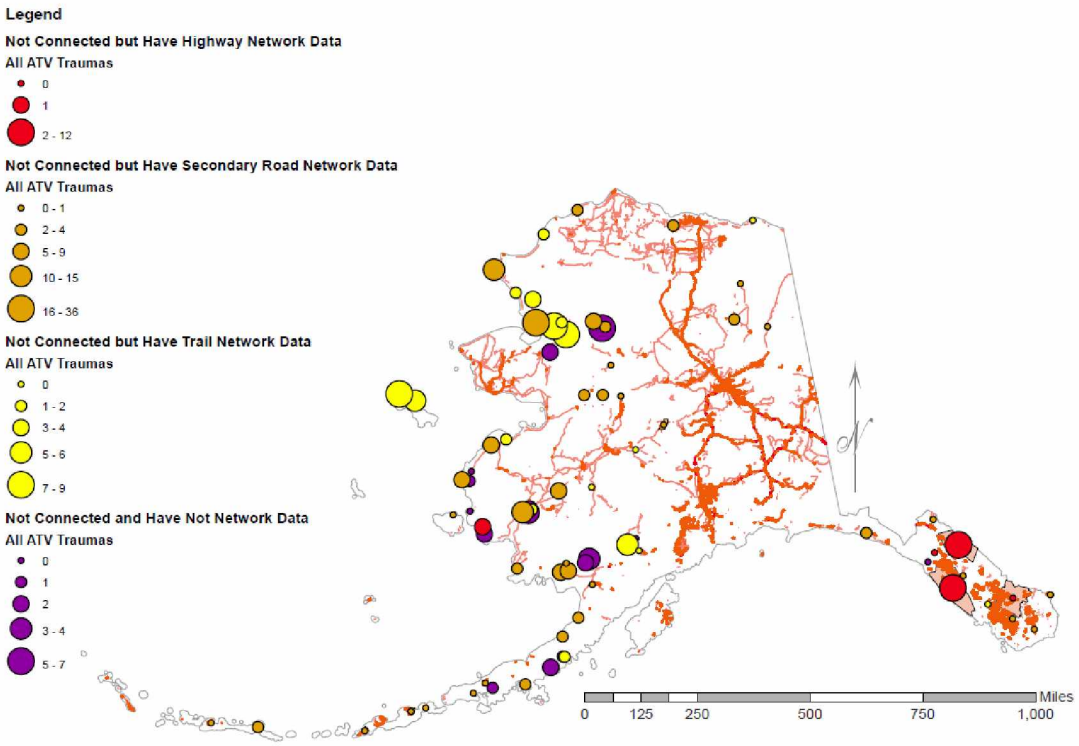


Figure 49. ATV traumas by location and the networks available in these places

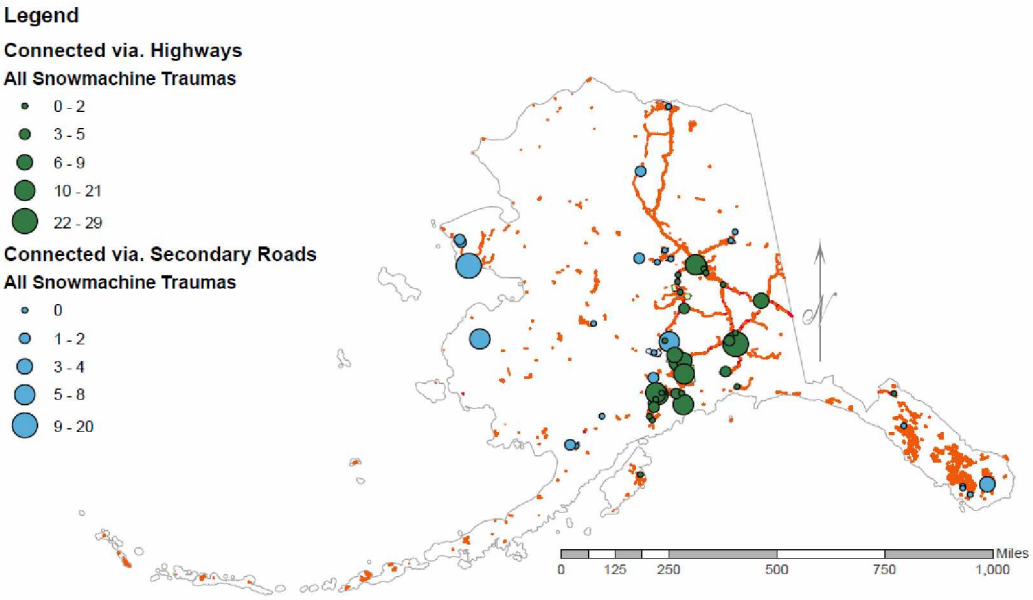


Figure 50. Snowmachine traumas by location and the network which connects these places

Figure 50 depicts a map of all snowmachine traumas that occurred in connected places. The map shows the snowmachine traumas that occurred in places connected by highways (green) and the snowmachine traumas that occurred in places connected by roads (blue). The snowmachine traumas in places connected by highways most often occur in the Interior, Cook Inlet, or Prince William Sound areas of Alaska. The snowmachine traumas in places connected by secondary roads occur all over the state, but often in the North Slope, Western Alaska, or Bristol Bay areas of the state.

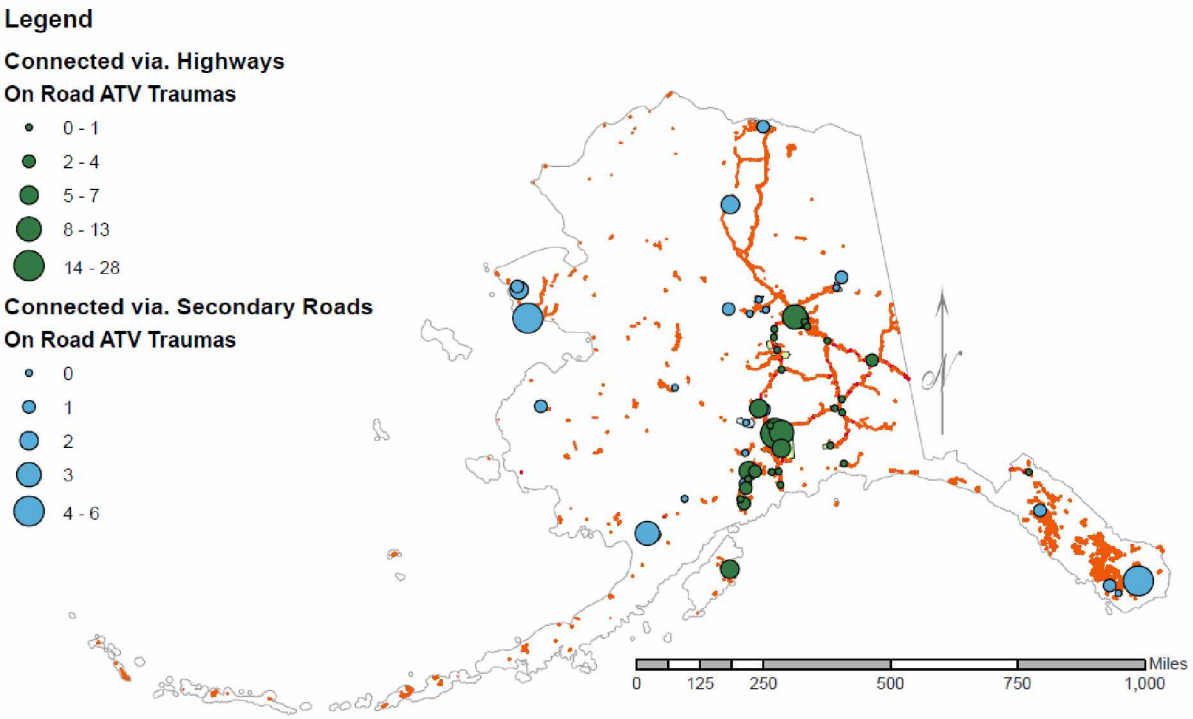


Figure 51. On-road ATV traumas by location and the network which connects these places

Figure 51 depicts a map of all on-road ATV traumas that occurred in places that are connected to other places. The map shows the ATV traumas that occurred in places connected by highways (green) and the ATV traumas that occurred in places connected by roads (blue). On-road ATV traumas in places connected by highways most often occur in the Interior or Cook Inlet areas of Alaska. The on-road ATV traumas in places connected by secondary roads occur all over the state, but the largest trauma numbers are in the Northwest Arctic, Bristol Bay, and Southeast Alaska regions with a few other locations in the North Slope, and Interior areas.

5 DISCUSSION/ CONCLUSION

The primary research goal was to collect and analyze nonconventional transportation mode data in Alaska to better inform policy and design that can meet the needs of rural and small urban communities. This goal was achieved in three phases. First, analyzing the Pacific Northwest Transportation Survey data in order to better understand unconventional transportation modes. Second, mapping of census defined populated places and transportation networks to assess connectivity. Thirdly, organizing the trauma registry data by mode and then by category and mapping it with the GIS connectivity analysis to determine the level significance of trauma locations by transportation mode. Additionally, future research directions and data sets are discussed.

The Pacific Northwest Transportation Survey data indicates that ATVs are used on or near roads 24% of the time and snowmachines are used on or near roads 23% of the time. The survey data also suggests that bicycles, pedestrians, and ATVs all serve an important role as transportation modes in Alaska. While snowmachines are used primarily for recreational purposes the data suggests that ATVs are not used merely for recreation but as primary modes of transportation performing tasks such as: to go to work, to go to school, for work, to go shopping, to go grocery shopping, and to go out for fun/entertainment.

Through preliminary modeling some key elements related to accessibility of trails for ATVs and snowmachines was illuminated. For ATV's people who haul their ATV with a trailer are much more likely to agree that they have adequate access to trails than a person who rides from home. Additionally, the odds that a person agrees that they have adequate access is smaller for people who ride more miles per year. The overall predictive accuracy of the ATV model is 43 percent. For snowmachines, a person who often or always rides on the shoulder of paved two lane roads has greater odds of stating that they have adequate access to trails. People who are separated/divorced/ widowed feel they have better access to trails than people that are married or single. Lastly, the odds that a person agrees that they have adequate access to trails is larger for people that are older in age. The overall predictive accuracy of the snowmachine model is 68 percent. The based on this preliminary modeling key factors for ATVs and snowmachines to feel that they have adequate access to trails seem to be how people access trails, how frequently they use their ATV or snowmachine, and their age. Both models have satisfactory prediction accuracy with the snowmachine model being more skilled at prediction than the ATV model. For surveys there is a lot of variability on how people respond, therefore it is difficult to predict how people will respond.

Road and highways connect 184 of the census defined populated places in Alaska, approximately 52% of all populated places. Trails alone connect 72 places (21% of all populated places), and 97 places (27% of all populated places) are not connected to any other places/ isolated places. On average 67% of the population is native Alaskan in isolated places, and the percentage of native Alaskans increases to about 88% when road and highway network data is not present.

As stated above, survey respondents reported using their ATVs on and near roadways 24% of the time, yet there are significantly more, 2 times as many, traumas in connected places as in isolated

places, and 3 times more traumas in highway connected places than in secondary road connected places. Comparably, bicycles are used on or near roadways 75% of the time and have 449 on-road traumas from 2004 – 2011 whereas ATVs had 352 on-road traumas even though they reportedly are only used on or near roadways 24% of the time. Again, snowmachines are used on and near roadways 23% of the time and have 3 times as many traumas in highway connected places than in secondary road connected places.

Highway connected places have a significantly higher risk of having ATV and snowmachine traumas than road connected places. This indicates that part of the issue could be the amount of traffic in connected areas, or perhaps the frequency of use of ATVs rather than automobiles in non-connected areas leading to fewer mixed-use scenarios. Looking at all of this data together there seems to be an indication of connected and urban locations having significantly more safety issues related to ATVs and other unconventional transportation modes. This indicates that either ATVs need alternative pathways that are safer, or different policies and design practices need to be implemented.

These findings illustrate the unique transportation environment in Alaska. It is important that, as engineers and city planners, we take into account the needs and preferences of the people living in the villages, towns and cities which we design and maintain. By integrating data in a spatial format trends and variations can be more visible and intuitive than numbers on a spreadsheet. Future research will seek to define the network structure of trail-connected places as well as the extent to which rivers, particularly during winter months, contribute to these informal networks. Additionally, projects geared toward obtaining real time counts of ATV and snowmachine use as well as bicycles and pedestrians to better understand why there are so many traumas related to their use on and near roadways will be considered. Sending out the same or a similar survey to the Pacific North west Transportation Survey will be considered for future years and efforts will be made to increase the sample size.

Future areas of study include a larger survey, meaning a more substantial number of respondents. A larger survey population would help to balance out the survey between variables and responses. In an ideal data set there would be substantially more survey responses than variables. Additionally, a larger number of respondents could give an even better view into what safety features and accessibility infrastructure which the people of Alaska need. There could also be counting stations set up to get live usage data for alternative and non-motorized transportation modes. Future work could also include doing additional connectivity analysis on places in Alaska and the United States. GIS data improves every year and by updating the network connectivity measures we are better able to understand what trends are state wide and which ones are related to connectivity in some way. Other networks such as rivers or waterways could also be analyzed as a factor of connectivity as well. Lastly, getting updated trauma registry data would aid in future research into traumas and how traumas are related to connectivity.

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7 APPENDICES

7.1 Appendix A – ATV and Snowmachine Statutes

Alaska Statute 28.10.011 requires that all motor vehicles driving "upon a highway or other public parking place" shall be registered. However, ATV's do not comply with Federal Department of Transportation standards for tires and rims. No ATV on the market today meets federal emission standards since no manufacturer has applied for such.

Therefore, they are deemed unsafe for road use and cannot be registered as motor vehicles.

SNOW VEHICLES

A vehicle with low-pressure tires, (3-wheel and 4-wheel ATV's) may qualify as a snow vehicle.

Such vehicles are required to be registered the same as snowmobiles (AS.05.30.120). This statute will permit you to have your ATV registered to prevent theft but does not mean it is licensed. Under Alaska

Statute 05.30.010, a person may not operate a snow vehicle off his private property unless the snow vehicle has been registered with the Division of Motor Vehicles.

AS 28.10.421 (Alaska Statutes) provides for a 2 year registration fee of $10.00.

Required equipment is outlined in 13 AAC 04.400 through 420 and refers to brakes, headlamps, throttle, and exhaust muffler.

RESPONSIBILITY

Alaska Statues 28.35.050 through 080 are general provisions for snow vehicles which direct procedures for accident reporting, penalty and the definition of snow vehicles. Section 05.90.001 gives guidelines for operating snow vehicles on state highways for special racing events.

Under the Administrative Code, parents can be cited for allowing their children to violate any of the snow vehicles and off highway vehicle sections.

Just remember, reckless driving with off roadway vehicles is an arrest able offense. You could be charged with trespassing if you ride on private property without permission. Any damages resulting may constitute criminal mischief and you are held criminally liable. Loud mufflers in residential areas bring complaints of disorderly conduct.

IMPOUND

Under 13 AAC 02.345(b) (2), a police officer may impound and remove to a place of safety a vehicle which is found or operated on a highway without license plates or registration.

Parent/Guardians, AS.34.50.020 places liability upon you for civil damages and court costs up to

$2,000 resulting from willful or malicious damage to real or personal property by minors under your legal custody.

Off highway vehicles are good working and recreational outlets for all Alaskans. Just operate them in a reasonable and safe manner, obey the State laws pertaining to them and be courteous toward others.

STATUTE

13 AAC 02.455 OPERATION ON HIGHWAYS AND OTHER LOCATIONS. (A) a snowmobile or an off-highway vehicle may be driven on the roadway or shoulder of a highway only under the following circumstances:

(1) when crossing a highway a provided in (f) of this section, or when traversing a bridge or culvert on a highway, but then only by driving at the extreme right-hand edge of the bridge or culvert and only when the traverse can be completed with safety and without interfering with other traffic on the highway.

(2) When use of the highway by other motor vehicles is impossible because of snow or ice accumulation of other natural conditions or when the highway is posted or otherwise designated as being open to travel by off-highway vehicles.

(3) When highway driving is authorized by an authority having jurisdiction over the highway, but only in accordance with restrictions which may be imposed by that authority with regard to highway use; or

(4) When driving on the right-of-way of a highway which is not a controlled-access highway, outside the roadway or shoulder, and no closer than three feet from the nearest edge of the roadway; night driving may be only on the right-hand side of the highway and in the same direction of the highway motor vehicle traffic in the nearest lanes of the roadway; no person may drive an off highway vehicle within the area dividing the roadways of a divided highway, except to cross the highway as provided in (f) of this section.

(f) A snowmobile or an off-highway vehicle may make a direct crossing of a highway if:

(1) the crossing is made approximately at a right angle to the highway and at a location where visibility along the highway in both directions is clear for a sufficient distance to assure safety, and the crossing can be completed safely and without interfering with other traffic on the highway, and;

(2) The vehicle is brought to a complete stop before crossing the shoulder or roadway, and the driver yields the right-of-way to all traffic on the highway.

(g) No snowmobile or other off highway vehicle may cross or travel on a sidewalk, a location intended for pedestrian or other non-motorized traffic, an alley, or a vehicular way or area which is not open to snowmobile or off-highway vehicle operation, except as provided in (f) of this section. (Eff. 12/31/69, Reg. 31; am 7/23/70, Reg. 35; am 6/28/79, Reg. 70)

7.2 Appendix B – IRB Forms

(907) 474-7800
(907) 474-5444 fax
uaf-irb@alaska.edu
www.uaf.edu/irb

Institutional Review Board

909 N Koyukuk Dr. Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

June 21, 2016

To: Nathan Belz, PhD
Principal Investigator

From: University of Alaska Fairbanks IRB

Re: [918111-1] Pacific Northwest Transportation Survey

Thank you for submitting the New Project referenced below. The submission was handled by Exempt Review. The Office of Research Integrity has determined that the proposed research qualifies for exemption from the requirements of 45 CFR 46. This exemption does not waive the researchers' responsibility to adhere to basic ethical principles for the responsible conduct of research and discipline specific professional standards.

Title:	Pacific Northwest Transportation Survey
Received:	June 2, 2016
Exemption Category:	*2*
Effective Date:	June 21, 2016

This action is included on the July 13, 2016 IRB Agenda.

Prior to making substantive changes to the scope of research, research tools, or personnel involved on the project, please contact the Office of Research Integrity to determine whether or not additional review is required. Additional review is not required for small editorial changes to improve the clarity or readability of the research tools or other documents.

IRB Exemption Request

Application

Complete this form only if you think your research may qualify as "exempt" from the requirements of 45 CFR 46. As the name implies, submission of this form is a request; the final determination of exemption status will be made by the Office of Research Integrity on behalf of the Institutional Review Board. If your project is not determined to be "exempt" you will have to complete a Research Protocol.

Additional information and instructions for completing this form are available as hidden text. **To view or hide the instructions click the show/hide formatting icon (¶) on your Word toolbar.** It is strongly recommended that you display the instructions while initially completing this form. The hidden text will not be visible if you print the document. If you have a MAC go to the Word menu, click Preferences, and then click View, under Non-printing characters, select the check box next to the "Hidden Test". Tip: You can also turn the All option on or off by clicking Show/Hide symbol on the menu bar paragraph symbol.

This form is an unlocked word document, so all MS Word tools and features are available. Do not change the text in any of the shaded areas of the form. Your responses to each question/section should be written where it says <<Overwrite Here>>; please keep the text of your response in the same blue 10 pt Arial font.

APPLICATION INFORMATION:

Proposed Start Date	June 21st, 2016
Anticipated Completion Date	December 31st, 2016

PRINCIPAL INVESTIGATOR ASSURANCE STATEMENT:

IRB protocols may only be submitted by individuals who are eligible to serve as a Principal Investigator (PI) under UAF policy #05-003 (http://www.uaf.edu/research/faculty/policies-and-regulations/Principal-Investigator-Eligibility.pdf).

By submitting this protocol application, I certify that the information provided is accurate and complete. I agree to and will comply with the following statements:

1. Abide by all regulations, policies and procedures applicable to research involving human subjects.
2. Accept responsibility for the scientific and ethical conduct of this research.
3. Accept responsibility for providing personnel (collaborators, staff, graduate students, undergraduate students, and volunteers) with the appropriate training and mentoring to conduct their duties as part of this research.
4. If this IRB Protocol Application is for Graduate Student Research, the student's graduate advisory committee has reviewed and approved this Exemption Request.
5. Submit any modified research procedures, research tools, consent/assent forms, etc. to the Office of Research Integrity.
6. Immediately report to the Office of Research Integrity any complaints from participants or others.

I realize that failure to comply with the above provisions may result in suspension or termination of this project by the IRB and, if appropriate, referral to the appropriate administrative official(s) for disciplinary action.

CLASSIFICATION OF PROJECT:

	Type of Project	Student Name (if needed)
x	Faculty Research	Dr. Nathan Belz

x	Doctoral or Master Degree Research	Carrie Sorensen, Interdisciplinary Studies (Transportation Statistics)
	Undergraduate Research Project	
	Other – Please describe.	

GENERAL OBJECTIVES AND METHODOLOGY:

The goal of this project is to: improve safety and minimize the dangers for all transportation mode types while traveling in mixed-use environments on rural facilities through the development and use of engineering and education safety measures. Mixed-use refers to the interaction of different modes of transportation such as non-traditional (ATV and snowmachine) and non-motorized (bicycle, pedestrian, mushing) types of transportation. Safety issues and perceptions will be obtained using an online survey.

PURPOSE(S) OF THE RESEARCH:

	Purpose
x	Contribute to generalizable knowledge.
	Assess the effectiveness of a specific program, method, practice, etc.:

EXEMPTION CATEGORIES:

	Exemption Category
	Exemption 1: Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
x	**Exemption 2:** Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, **unless**: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; **and** (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.
	Exemption 3: Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior that is not exempt under Category 2, **if** (i) the human subjects are elected or appointed public officials or candidates for public office; **or** (ii) Federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
	Exemption 4: Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, **if** these sources are (i) publicly available **or** (ii) if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
	Exemption 5: Research and demonstration projects which are **conducted by or subject to** the approval of Department or Agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for the benefits or services under those programs.
	Exemption 6: Taste and food quality evaluation and consumer acceptance studies, **if** (i) wholesome foods without additives are consumed **or** (ii) a food is consumed that contains a food ingredient at or below the

	level and for a use found to be safe, or an agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency of the Food Safety and Inspection Service of the U.S. Department of Agriculture.

PROTECTED GROUPS:

	Protected Group
	Children *(individuals under 18 years of age)*
	Pregnant Women *(in projects where there is the potential for fetal harm/impact)*
	Prisoners

RESEARCH TOOLS: *Copies of all research tools must be submitted with your completed Exemption Request form.*

	Data Collection Methods or Instruments
x	Questionnaires.
	Interviews.
	Observations.
	Focus Groups.
	Review of Archived Data / Records / Samples.
	Consent Document or Script. *Required if consent information is not incorporated in a research instrument.*

IRB Research Protocol
Application

Instructions for completing this form are available as hidden text. **To view or hide the instructions click the show/hide formatting icon (¶) on your Word toolbar.** It is strongly recommended that you display the instructions while initially completing this form. The instructions can be hidden once the Protocol is ready to submit to the IRB. The instructions will not be visible if you print the document. If you have a MAC go to the Word menu, click Preferences, and then click View, under Non-printing characters, select the check box next to the "Hidden Test". Tip: You can also turn the All option on or off by clicking Show/Hide symbol on the menu bar paragraph symbol.

Do not change the text in any of the shaded areas of the form. Your responses to each question/section should be written where it says <<Overwrite Here>>; please keep the text of your response in the same blue 10 pt Arial font.

A. APPLICATION INFORMATION:

Title:	Pacific Northwest Transportation Survey
Proposed Start Date	June 21st, 2016
Anticipated Completion Date	December 31st, 2016

B. PRINCIPAL INVESTIGATOR ASSURANCE STATEMENT:

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By submitting this protocol application, I certify that the information provided is accurate and complete. I agree to and will comply with the following statements:

1. Abide by all regulations, policies and procedures applicable to research involving human subjects.
2. Accept responsibility for the scientific and ethical conduct of this research.
3. Accept responsibility for providing personnel (collaborators, staff, graduate students, undergraduate students, and volunteers) with the appropriate training and mentoring to conduct their duties as part of this research.
4. If this IRB Protocol Application is for Graduate Student Research, the student's graduate advisory committee has reviewed and approved this research protocol.
5. Obtain approval from the IRB prior to amending or altering the research protocol, consent/assent forms or initiating further correspondence with the research subjects,
6. Immediately report to the Office of Research Integrity any complaints from participants or others, all serious adverse reactions, and/or any unanticipated problems or issues related to this study.
7. Comply with requests of the IRB regarding Continuing/Final Review and assessment in a timely manner.

I realize that failure to comply with the above provisions may result in suspension or termination of this project by the IRB and, if appropriate, restricted access to funding and notification of sponsor, and referral to the appropriate UAF administrative official(s) for disciplinary action.

C. Funding Information:

	Type of Funding	Sponsor or Source	UAF proposal (S#), Grant (G#), or Account (fund-org)
	Internal Competitive	n/a	n/a
	Internal Non-Competitive	n/a	n/a
	External	PacTrans	103010-67048-339320
	Other	n/a	n/a

Justification of Multiple Awards:

n/a

D. Classification of Project:

	Type of Project	Description (if needed)
x	Faculty Research	Dr. Nathan Belz
x	Doctoral or Master Degree Research	Carrie Sorensen, Interdisciplinary Studies (Transportation Statistics)
	Undergraduate Research Project	
	Other – Please describe.	

E. Additional IRB Requirements:

Required Information	Response
Name of Committee	Institutional Review Board
Institution	University of Alaska - Fairbanks
Contact Person	Gretchen Hundertmark
Email Address	ghundertmark@alaska.edu
Phone Number	907-474-7800

	Review Status	Explanation (if needed)
	Application has not been submitted.	<<Overwrite Here>>
	Application is currently under review.	<<Overwrite Here>>
	Application has been approved.	<<Overwrite Here>>
	Other – Please explain.	<<Overwrite Here>>

F. General Objectives and Methodology:

The goal of this project is to: improve safety and minimize the dangers for all transportation mode types while traveling in mixed-use environments on rural facilities through the development and use of engineering and education safety measures. Mixed-use refers to the interaction of different modes of transportation such as non-traditional (ATV and snowmachine) and non-motorized (bicycle, pedestrian, mushing) types of transportation. Safety issues and perceptions will be obtained using an online survey.

G. Literature Search (References):

Federal Highway Administration. (2010). Factors Contrubuting to Pedestrian and Bicycle Crashes on Rural Highways. McLean, VA: U.S. Department of Transportation.

Garland, S. (2014). National Estimates of Victim, Driver, and Incident CHaracteristics for ATV-Related, Emergency Department-Treated Injuries in the United States from January 2010-August 2010. Bethesda, MD: Consumer Product Safety Commission.

International Snowmobile Manufacturers Association. (2014). Facts and Statistics. Retrieved October 12, 2014, from http://www.snowmobile.org/pr_snowfacts.asp

Jennisan, C., Harland, K., Ellis, D., & G., D. (2012). All-terrain vehicles: deadly on and off the road. Injury Prevention, 18, 192-193.

Jennisen, C., Denning, G., Peck, J., Wetjen, K., Hoogerwerf, P., & Harland, K. (2012, October). Got Wheels? Adolescent Exposure to All-Terrain Vehicles and their Driving Practices. Annals of Emergency Medicine, 60(4), pp. 99-100.

Landen, M. e. (1999). Injuries Associated with Snowmobiles. Public Health Reports No. 114, p48.

Mishkovsky, N., Dalbey, M., Bertaina, S., Read, A., & McGaillard, T. (2010). Putting Smart Growth to Work in Rural Communities. Washington, D.C.: International City/County Management Association.

Peek-Asa, C., Sprince, N., Whittem, P., Falb, S., Madsen, M., & Zwerling, C. (2007). Characteristics of crashes with farm equipment that increase potential for injury. Journal of Rural Health 23(4), 339-347.

Pierz, J. (2003). Snowmobile Injuries in North America. Clinical Orthopaedics and Related Research, 29-36.

Snyder, C., Muensterer, O., Sacco, F., & Safford, S. (2014). Helmet Use Among Alaskan Children Involved in Off-Road Motorized Vehicle Crashes. International Journal of Circumpolar Health.

Topping, J., & Garland, S. (2012). 2012 Annual Report of ATV-Related Deaths and Injuries. Bethesda, MD: U.S. Consumer Product Safety Commission, Division of Hazard Analysis.

USDOT. (2014). Safer People, Safer Streets: Summary of US Department of Transporation Action Plan in Increase Walking and Biking and Reduce Pedestrian and Bicyclist Fatalities. Washington, D.C.: US Department of Transporation.

Williams, A., Oesch, S., McCartt, A., Teoh, E., & Sims, L. (2014). On-road all-terrain vehicle ATV fatalities in the United States. Journal of Safety Research, 50, 117-123.

H. Research Population:

Required Information	Response
1. Maximum number of research participants to be enrolled.	Unlimited
2. What are the selection criteria for research participants?	Random (people that elect to take an online questionnaire)
3. Discuss which populations are specifically excluded from the research?	No populations are anticipated to be specifically excluded

I. Protected Groups:

	Protected Group
	Children *(individuals under 18 years of age)*
	Pregnant Women *(in projects where there is the potential for fetal harm/impact)*
	Prisoners

J. RECRUITMENT:

Required Information	Response
1. Discuss the recruitment process. *Note: You must include copies of any proposed recruitment materials with your IRBNet submission package.*	No recruitment; participants will self-elect to participate in the survey. Local user groups (e.g., Fairbanks Cycle Club, Alaska Dog Mushers Association, etc.) will be contacted about the survey and asked to help distribute the survey link.
2. Discuss how you plan to encourage the participation of women and minorities.	Since the survey is administered at random, women and minorities will be included only if they are selected and are willing to participate. We anticipate and will encourage participation of individuals from rural villages and tribes.

K. BENEFITS, COSTS, RISKS, COMPENSATION:

Question	Response
1. What are the potential benefits to an individual research participant?	Contribution to ongoing research related to mixed-use and non-traditional travel mode safety in Alaska and the Pacific Northwest. Participants can be entered into a random drawing for a $25 Amazon gift card.
2.If applicable, what are the potential benefits to the culture or society that is the subject of the research?	The direct and specific benefits of this project are a number of guidelines with the intention to improve safety for non-traditional and non-motorized users of the transportation network. Through identifying high risk areas, both targeted engineering and non-engineering strategies will address safety on rural mix-use facilities by focusing on the following four primary areas: Education | Increase knowledge and compliance with safe operating practices | Increase user awareness appropriate sharing behavior on mixed-use facilities | Increase public and private partnerships to encourage training for young operators/users Enforcement | Encourage strict enforcement of NTV operation Engineering | Consider mixed-use needs in transportation planning and design | Provide safer crossing and shared-use environments Policy | Improve NTV and NMT crash data (public safety and medical partnerships, etc.) | Identify high risk locations and support more focused enforcement efforts | Encourage collaboration between local communities and decision makers to address unique mobility needs
3. Will compensation (cash, gift cards, non-monetary gifts, etc.) be provided to research participants? If yes, describe the compensation to be offered, how it will be distributed, and what records will be kept.	Yes. $25 Amazon gift cards will be distributed to 20 participants at random. Participants must provide a valid email address to be eligible for the drawing. This email address will be used to contact them and distribute the gift cards. Email address will not be linked to the survey responses.
4. What are the costs (monetary or time) to an individual research participant?	No monetary cost; approximately 15 minutes of their time.
5. Describe the risk of potential harm or discomfort (physical, psychological, or sociological) to a individual research participant?	No risk of harm or discomfort.
6. What will be done to minimize or mitigate potential harms or discomfort	As stated above, there is no risk of harm or discomfort. Participation is completely voluntary and the subject may elect to discontinue the survey at any time.

that may be experienced by an individual research participant?	
7. If applicable, what are the potential risks to the culture or society that is the subject of the research?	No foreseen risks.
8. If applicable, what will be done to minimize or mitigate potential harms to the culture or society that is the subject of the research?	As stated above, there are no foreseen risks.

L. PARTICIPANT CONSENT / ASSENT:

RESEARCH REQUESTS:

	Request	Justification
	1. Waiver of informed consent.	n/a
x	2. Waiver of the requirement for documentation (written, audio or video) of informed consent:	This project is exempt and the survey is short; consent will be obtained when the person elects to begin the survey. As such, we request to waive the requirement to provide documentation of informed consent.
	3. Greater than 8th grade reading level for consent or assent materials.	n/a
	4. Inclusion of participants whose primary language is not English.	n/a
	5. Inclusion of adults with diminished mental capabilities.	n/a

CONSENT/ASSENT PROCESS:

Participant will select the "Begin Survey" button on the survey website.

M. RESEARCH METHODOLOGY:

RESEARCH PLAN:

Required Information	Response
1. What is (are) the specific questions that the research seeks to answer?	1) How can we most effectively and safely accommodate personal transportation in spaces where mixed-use travel occurs? 2) How do we limit the improper or inappropriate use of public right-of-way on facilities where mixed-use travel occurs? 3) How do we ensure that we maintain mobility for those with limited travel options?
2. If identifying data will be collected, how will participant confidentiality be maintained?	Email addresses will be obtained for participants that elect to enter the drawing for gift cards. This will be stored locally on the PIs computer and used only for the drawing and distribution of gift cards. The list of emails will be destroyed (deleted) after the gift cards have been issued.

3. How will the data be used? Include all planned uses (i.e. presentation at scholarly meetings, journal articles, dissertation or thesis, agency reports, presented at public meetings, etc.)	Results and findings from the survey will be included in the PacTrans final report, presentation at scholarly meetings, included in journal articles, and in a masters thesis.
4. Where will the project be conducted? Provide the specific physical location.	UAF, online.

RESEARCH TOOLS:

	Data Collection Methods or Instruments
x	Questionnaires.
	Interviews.
	Observations.
	Focus Groups.
	Review of Archived Data / Records / Samples.

N. POTENTIAL CONFLICTS OF INTEREST OR COMMITMENT:

Y	N		Explanation (required for all yes answers)
		1. Does any member of the research team have a proprietary interest in the project that may result in patents, trademarks, or licensing agreements? If so, the researcher will need to work with the Office of Technology Transfer to protect these rights.	No.
		2. Does any member of the research team have any equity / financial interest in the research? This would include incentive payments, but not regular salary or stipends.	No.
		3. Does any member of the research team have a power relationship with any or all of the research participants? A power relationship is one that may influence the perception of voluntariness of participation (e.g. employer/employee, counselor/client, or teacher/student)?	No.
		4. Does any member of the research team have any other potential or actual conflict of interest or commitment relative to this research?	No.

O. DATA STORAGE AND RETENTION:

Required Information	Response
1. What is the form in which the data will be collected or recorded? *(Examples: paper instruments, electronic records, field notes, audio recordings, etc.)*	Survey Monkey, Excel.

2. Where will the data be stored during the life of the project?	Data will remain with the PI (Nathan Belz) and Co-PI (Kevin Chang) from the University of Idaho during the project and stored on the Survey Monkey account and a backup copy kept on a USB thumb drive.
3. What will be done with the data at the end of the project?	Data will be stored by the PI at the end of data collection. Security of the data will be maintained by physical transfer of the data.
4. If the data will be maintained after the end of the project, where will it be stored and who will be responsible for maintaining and securing it?	Data will be stored on a local USB drive; PI will be responsible for maintaining and securing the data under lock or supervision in 245 Duckering. Data will not be used but kept on record for PacTrans (funding agency)
5. If the data will be maintained after the end of the project, how long will it be stored or archived?	Data will be stored indefinitely.
6. Who will be responsible for maintaining or ultimately disposing of the data?	PI will be responsible for maintaining the data.
7. How will data be transferred or shared among research team members? *(Examples: data will be maintained on a secure server that is only accessible to research team members, data will be transferred to non-UAF collaborators on encrypted CD/DVDs sent via Federal Express, etc.)*	Data will be stored and transferred using external hard drives to remain locked in the PI's office.
8. Do you have or plan to apply for a Certificate of Confidentiality from the National Institutes of Health?	No.

IRB Research Protocol

Project Personnel List

All listed personnel must create an IRBNet account and be given at least read access to the Research Protocol or Exemption Request in IRBNet.

PERSONNEL INFORMATION: *Minors (<18 years of age) must be approved by UAF Risk Management before working on any UAF project.*

Name:

Nathan Belz, Ph.D.

UAF Status *(e.g. faculty, staff, undergraduate, volunteer, etc.)*:

Faculty

Specific Duties & Responsibilities on this Protocol *(e.g. design the research tools, recruit subjects, obtain subject consent/assent, collect data, perform analysis, transcribe data, advise student researcher, etc.)*:

Survey Design, survey dissemination, survey analysis, advise graduate student researcher (identified in the activity report)

Will this person have contact with research participants or their identifiable data?

No direct contact other than those selected to receive the $25 gift card.

If reportable information, for example child abuse, may be obtained from participants, please indicate in this space whether or not this person has any mandated reporting responsibilities (as a counselor or mental health professional, social worker, etc.) *Note: You must make it clear to participants if their responses may be reported to social services or law enforcement.*

No such information will be obtained.

Name:

Carrie Sorensen

UAF Status *(e.g. faculty, staff, undergraduate, volunteer, etc.)*:

Graduate Student

Specific Duties & Responsibilities on this Protocol *(e.g. design the research tools, recruit subjects, obtain subject consent/assent, collect data, perform analysis, transcribe data, advise student researcher, etc.)*:

Survey Design, survey dissemination, survey analysis

Will this person have contact with research participants or their identifiable data?

No.

If reportable information, for example child abuse, may be obtained from participants, please indicate in this space whether or not this person has any mandated reporting responsibilities (as a counselor or mental health professional, social worker, etc.) *Note: You must make it clear to participants if their responses may be reported to social services or law enforcement.*

No such information will be obtained.

Name:

Kevin Chang, Ph.D.

UAF Status *(e.g. faculty, staff, undergraduate, volunteer, etc.)*:

Non-UAF faculty (University of Idaho)

Specific Duties & Responsibilities on this Protocol *(e.g. design the research tools, recruit subjects, obtain subject consent/assent, collect data, perform analysis, transcribe data, advise student researcher, etc.)*:

Survey Design, survey dissemination, survey analysis, advise graduate student researcher (identified in the activity report)

Will this person have contact with research participants or their identifiable data?

No direct contact other than those selected to receive the $25 gift card.

If reportable information, for example child abuse, may be obtained from participants, please indicate in this space whether or not this person has any mandated reporting responsibilities (as a counselor or mental health professional, social worker, etc.) *Note: You must make it clear to participants if their responses may be reported to social services or law enforcement.*

No such information will be obtained.

Name:

Nick Schlotthauer

UAF Status *(e.g. faculty, staff, undergraduate, volunteer, etc.)*:

Graduate Student, University of Idaho

Specific Duties & Responsibilities on this Protocol *(e.g. design the research tools, recruit subjects, obtain subject consent/assent, collect data, perform analysis, transcribe data, advise student researcher, etc.)*:

Survey Design, survey dissemination, survey analysis

Will this person have contact with research participants or their identifiable data?

No.

If reportable information, for example child abuse, may be obtained from participants, please indicate in this space whether or not this person has any mandated reporting responsibilities (as a counselor or mental health professional, social worker, etc.) *Note: You must make it clear to participants if their responses may be reported to social services or law enforcement.*

No such information will be obtained.

7.3 Appendix C – Pacific North West Transportation Survey

Welcome to the Pacific Northwest Transportation Survey!

Your input is important and will help transportation professionals develop a better understanding of travel and infrastructure needs in the Pacific Northwest (AK, ID, OR, and WA). The survey will take about **20 minutes of your time** and you must be **18 years or older to participate**.

By clicking the "Next" button at the bottom of this page you consent to participating in the survey. The survey is anonymous, but if you would like to be entered into the drawing for one of **twenty $25 Amazon.com gift cards** you will be required to provide a name and a valid e-mail address so we can contact you if you are selected.

If you have questions about the survey, contact:
Dr. Nathan Belz, University of Alaska Fairbanks (npbelz@alaska.edu or 907-474-5765) or
Dr. Kevin Chang, University of Idaho (kchang@uidaho.edu or 208-885-4028).

If you have questions or concerns about your rights as a research participant, contact the UAF Office of Research Integrity at uaf-irb@alaska.edu or 1-866-876-7800.

NOTE: After starting the survey, if you need to revert back to a previous page in the survey, use the **"Prev"** button located at the bottom of the page. **DO NOT USE THE BACK BUTTON ON YOUR BROWSER** as this action will take you out of the survey and you will lose your responses.

Let's begin!
(click "Next" below)

Household/Residence Characteristics

1. How would you best describe your primary residence?

- ◯ House (not on farmland or open space)
- ◯ House (on working farmland, in major open space, or secluded wooded area)
- ◯ Apartment, townhouse, condominium, multi-family house (duplex)
- ◯ Dormitory or other institutional housing

Other (please specify)

2. In general, what types of housing can be found within a half a mile of your current home?

- [ ] House (not on farmland or open space)
- [ ] House (on working farmland, in major open space, or secluded wooded area)
- [ ] Apartment, townhouse, condominium, multi-family house (duplex)
- [ ] Dormitory or other institutional housing

Other (please specify)

3. How many adults 18 years old or older, including yourself, are currently living in your home?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5+

4. How many children under the age of 18 are currently living in your home?

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5+

5. My neighborhood has an adequate number of good sidewalks or walking paths.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neither Agree nor Disagree
- ◯ Disagree
- ◯ Strongly Disagree
- ◯ Don't know or Not Applicable

6. My residence has adequate parking for my car(s).

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neither Agree nor Disagree
- ◯ Disagree
- ◯ Strongly Disagree
- ◯ Don't Know or Not Applicable

* 7. In which one of the following areas do you consider your current home to be?

- ◯ Rural area (open land with few homes and buildings)
- ◯ Urban area (region in or surrounding a city)

Household/Residence Characteristics

8. Select a rural subcategory that best describes where your home is.

- ◯ Edge (at the fringe of metropolitan areas and typically connected to them by state and interstate highways)
- ◯ Traditional Main Street (have compact street design that is often accessible to a transportation hub; historically significant architecture and public spaces)
- ◯ Gateway (adjacent to high-amenity recreational areas such as National Parks, National Forests, and coastlines)
- ◯ Resource Dependent (surrounded by or in proximity to single industries i.e., agriculture and mining)
- ◯ Remote (tribal, village, and/or isolated)

Vehicle Ownership

9. How many of each transportation mode listed below does your household own?

	0	1	2	3	4	5+
Car or Truck	○	○	○	○	○	○
Motorcycle	○	○	○	○	○	○
Bicycle	○	○	○	○	○	○
ATV (All-terrain vehicle)	○	○	○	○	○	○
Snowmachine/Snowmobiles	○	○	○	○	○	○
Dogsled or Dog-powered	○	○	○	○	○	○
Agricultural Vehicle	○	○	○	○	○	○

Commute Characteristics

10. What is your ONE-WAY commute distance to work?

- ○ Less than one mile
- ○ 1-5 miles
- ○ 6-15 miles
- ○ 16-30 miles
- ○ 30+ miles
- ○ Not applicable

11. What is your ONE-WAY commute distance to the nearest town center?

- ○ Less than one mile
- ○ 1-5 miles
- ○ 6-15 miles
- ○ 16-30 miles
- ○ 30+ miles
- ○ Not applicable

12. For each trip purpose below, select the transportation type that you use most often.

	Car or Truck	Motorcycle	Walk or Jog	Bicycle	ATV	Snowmachine or Snowmobiles	Dog Sled or Dog-Powered	Agricultural Vehicle	Other	N/A
To go to work	○	○	○	○	○	○	○	○	○	○
For work	○	○	○	○	○	○	○	○	○	○
To go to school	○	○	○	○	○	○	○	○	○	○
To go shopping	○	○	○	○	○	○	○	○	○	○
To go to out for fun/entertainment	○	○	○	○	○	○	○	○	○	○
To go grocery shopping	○	○	○	○	○	○	○	○	○	○

Frequency of Vehicle/Mode Use

* 13. How frequently do you drive an automobile on, adjacent to, or near a roadway?

- ○ Always
- ○ Often
- ○ Sometimes
- ○ Rarely
- ○ Never

* 14. How frequently do you ride a motorcycle on, adjacent to, or near a roadway?

- ○ Always
- ○ Often
- ○ Sometimes
- ○ Rarely
- ○ Never

* 15. How frequently do you walk on, adjacent to, or near a roadway?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

* 16. How frequently do you ride a bicycle on, adjacent to, or near a roadway?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

* 17. How frequently do you ride an ATV on, adjacent to, or near a roadway?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

* 18. How frequently do you ride a snowmachine/snowmobile on, adjacent to, or near a roadway?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

* 19. How frequently do you use dog-powered assistance (e.g. dogsled, skijoring, bikejor) on, adjacent to, or near a roadway?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

* 20. How frequently do you drive an agricultural vehicle on, adjacent to, or near a roadway?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

* 21. Do you travel on, adjacent to, or near a roadway using a different mode (or type) of transportation that was not previously mentioned?

- ◯ Yes
- ◯ No

Estimate of Miles/Hours of Use

22. For the mode of transportation previously not mentioned, what type is it and how many hours and miles do you travel by this mode in a year?

Type: _____

Hours: _____

Miles: _____

Automobiles

The following questions are about your personal automobile ownership and use.

23. How many individuals, including yourself, drive an automobile in your household?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

24. On average, how many miles do you drive your personal automobile in a year?

- ◯ Less than 10,000
- ◯ 10,000-20,000
- ◯ 20,001-40,000
- ◯ 40,001-60,000
- ◯ More than 60,000

25. How did you learn to drive an automobile? Select all that apply.

- ☐ Driver Education Course
- ☐ Received training from friend or relative
- ☐ Self-taught
- ☐ Other (please specify)

Motorcycles

The following questions are about your motorcycle ownership and use.

26. How many individuals, including yourself, ride a motorcycle in your household?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

27. On average, how many miles do you ride a motorcycle in a year?

- ◯ Less than 10,000
- ◯ 10,000-20,000
- ◯ 20,001-40,000
- ◯ 40,001-60,000
- ◯ More than 60,000

28. How did you learn to ride a motorcycle? Select all that apply.

- ☐ Driver Education Course
- ☐ Received training from friend or relative
- ☐ Self-taught
- ☐ Other (please specify)

ATVs

The following questions are about your ATV ownership and use.

29. How many individuals, including yourself, ride an ATV in your household?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

30. How many of these individuals are under the age of 16?

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

31. On average, how many miles do you ride an ATV in a year?

- ◯ Less than 100
- ◯ 100-250
- ◯ 251-500
- ◯ 501-1,000
- ◯ 1,001-2,000
- ◯ 2,001-4,000
- ◯ More than 4,000

32. On average, how many hours do you put on your ATV in a year?

- ◯ Less than 50
- ◯ 50-100
- ◯ 101-200
- ◯ 201-400
- ◯ 401-600
- ◯ More than 600

33. I ride my ATV for:

- ◯ Only recreational uses (e.g., hunting, trail riding, etc.)
- ◯ Mostly recreational uses
- ◯ Some recreational and some utilitarian uses
- ◯ Mostly utilitarian uses (e.g., errands, daily travel, etc.)
- ◯ Only utilitarian uses

34. How frequently do you ride your ATV on the following types of road components?

	Always	Often	Sometimes	Rarely	Never
On the shoulders of two lane roads (paved)	◯	◯	◯	◯	◯
On the shoulders of two lane highways (paved)	◯	◯	◯	◯	◯
On the shoulders of multilane highways (paved)	◯	◯	◯	◯	◯
Bike lanes on roads	◯	◯	◯	◯	◯
Sidewalks	◯	◯	◯	◯	◯
Bike/walking path/trail	◯	◯	◯	◯	◯

35. How did you learn to ride an ATV? Select all that apply.

- ☐ Organized training
- ☐ Received training from friend or relative
- ☐ Self-taught
- ☐ Other (please specify)

* 36. I feel that there are adequate trail opportunities to ride my ATV near my home.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neither Agree nor Disagree
- ◯ Disagree
- ◯ Strongly Disagree
- ◯ Don't Know or Not Applicable

ATVs

37. How do you typically access those trails?

- ◯ Ride directly from my home
- ◯ Haul them by trailer to a trailhead
- ◯ Other (please specify)

38. How far do you travel to reach opportunities to ride ATVs?

- ◯ Less than one mile
- ◯ 1-5 miles
- ◯ 6-15 miles
- ◯ 16-30 miles
- ◯ 30+ miles
- ◯ Not applicable

39. Why do you most commonly ride an ATV? Select all that apply.

- ☐ Commuting or for work
- ☐ Commuting or for school
- ☐ Recreation/Exercise
- ☐ Personal trips (i.e., errands, picking up someone, visiting others)
- ☐ Other (please specify)

* 40. Have you ever been in a crash with an automobile while riding an ATV?

- ◯ Yes
- ◯ No
- ◯ I prefer not to answer

ATVs

41. Did your last crash with an automobile occur on public or private property?

- ◯ On public property
- ◯ On private property

42. While riding an ATV, where did your last crash with an automobile occur?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

43. Which of the following occurred as a result of the crash with an automobile? Select all that apply.

- ☐ No damage or injury
- ☐ Property damage only
- ☐ Personal injury/Injury to others
- ☐ Fatality
- ☐ Other (please specify)

44. In your opinion, what might have been done to prevent the crash with an automobile?

45. Does riding an ATV in mixed traffic seem to reduce your safety?

- ◯ Yes
- ◯ No
- ◯ N/A

46. What are some road characteristics you have observed that made you feel safer while riding in mixed traffic? Select all that apply.

- ☐ Signage that cautions automobile drivers that non-traditional and non-motorized vehicles (i.e. ATVs) may be present
- ☐ Pavement markings that section off an area for non-traditional and non-motorized vehicle (i.e. ATVs) use
- ☐ Wider lanes
- ☐ Wider shoulders
- ☐ Lighting
- ☐ Not applicable
- ☐ Other (please specify)

* 47. Have you ever been in a crash riding an ATV that involved a different non-traditional and/or non-motorized mode (such as pedestrians, snowmachines, or bicycles)?

- ◯ Yes
- ◯ No
- ◯ I prefer not to answer

ATVs

48. Did this crash occur on public or private property?

- ◯ On public property
- ◯ On private property

49. Where did this crash occur?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

50. Which of the following occurred as a result of the crash? Select all that apply.

- ☐ No damage or injury
- ☐ Property damage only
- ☐ Personal injury/Injury to others
- ☐ Fatality
- ☐ Other (please specify)

51. In your opinion, what might have been done to prevent this crash?

52. Do you make yourself more visible when riding an ATV? Select all that apply.

- ☐ Wear bright colors
- ☐ Wear fluorescent or reflective clothing
- ☐ Wear other lights on self or belongings
- ☐ Use additional reflectors
- ☐ Accessorize with safety flags or similar objects
- ☐ N/A
- ☐ Other (please specify)

53. If you use these features to make yourself more visible, when do you use them?

- ◯ Day time only
- ◯ Night time only
- ◯ Both
- ◯ N/A

54. How often do you wear a helmet when riding?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

Snowmachines/Snowmobiles

The following questions are about your snowmachine/snowmobile ownership and use.

55. How many individuals, including yourself, ride a snowmachine in your household?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

56. How many of these individuals are under the age of 16?

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

57. On average, how many miles do you ride a snowmachine in a year?

- ◯ Less than 100
- ◯ 100-250
- ◯ 251-500
- ◯ 501-1,000
- ◯ 1,001-2,000
- ◯ 2,001-4,000
- ◯ More than 4,000

58. On average, how many hours do you put on your snowmachine in a year?

- ◯ Less than 50
- ◯ 50-100
- ◯ 101-200
- ◯ 201-400
- ◯ 401-600
- ◯ More than 600

59. I ride my snowmachine/snowmobile for:

- ◯ Only recreational uses (e.g., hunting, trail riding, etc.)
- ◯ Mostly recreational uses
- ◯ Some recreational and some utilitarian uses
- ◯ Mostly utilitarian uses (e.g., errands, daily travel, etc.)
- ◯ Only utilitarian uses

60. How frequently do you ride on the following types of road components?

	Always	Often	Sometimes	Rarely	Never
On the shoulders of two lane roads (paved)	○	○	○	○	○
On the shoulders of two lane highways (paved)	○	○	○	○	○
On the shoulders of multilane highways (paved)	○	○	○	○	○
Bike lanes on roads	○	○	○	○	○
Sidewalks	○	○	○	○	○
Bike/walking path/trail	○	○	○	○	○

61. How did you learn to ride a snowmachine? Select all that apply.

- ☐ Organized training
- ☐ Received training from friend or relative
- ☐ Self-taught
- ☐ Other (please specify)

* 62. I feel that there are adequate trail opportunities to ride my snowmachine near my home.

- ○ Strongly Agree
- ○ Agree
- ○ Neither Agree nor Disagree
- ○ Disagree
- ○ Strongly Disagree
- ○ Don't Know or Not Applicable

Snowmachines/Snowmobiles

63. How do you typically access those trails?

- ◯ Ride directly from my home
- ◯ Haul them by trailer to a trailhead
- ◯ Other (please specify)

64. How far do you travel to reach opportunities to ride snowmachines?

- ◯ Less than one mile
- ◯ 1-5 miles
- ◯ 6-15 miles
- ◯ 16-30 miles
- ◯ 30+ miles
- ◯ Not applicable

65. Why do you most commonly ride a snowmachine? Select all that apply.

- ☐ Commuting or for work
- ☐ Commuting or for school
- ☐ Recreation/Exercise
- ☐ Personal trips (i.e., errands, picking up someone, visiting others)
- ☐ Other (please specify)

* 66. Have you ever been in a crash with an automobile while riding a snowmachine?

- ◯ Yes
- ◯ No
- ◯ I prefer not to answer

Snowmachines/Snowmobiles

67. Did your last crash with an automobile occur on public or private property?

- ◯ On public property
- ◯ On private property

68. While riding a snowmobile, where did your last crash with an automobile occur?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

69. Which of the following occurred as a result of the crash with an automobile? Select all that apply.

- ☐ No damage or injury
- ☐ Property damage only
- ☐ Personal injury/Injury to others
- ☐ Fatality
- ☐ Other (please specify)

70. In your opinion, what might have been done to prevent the crash with an automobile?

71. Does riding a snowmachine in mixed traffic seem to reduce your safety?

- ◯ Yes
- ◯ No
- ◯ N/A

72. What are some road characteristics you have observed that made you feel safer while riding in mixed traffic? Select all that apply.

- [ ] Signage that cautions automobile drivers that non-traditional and non-motorized vehicles (i.e. ATVs) may be present
- [ ] Pavement markings that section off an area for non-traditional and non-motorized vehicle (i.e. ATVs) use
- [ ] Wider lanes
- [ ] Wider shoulders
- [ ] Lighting
- [ ] Not applicable
- [ ] Other (please specify)

* 73. Have you ever been in a crash riding a snowmachine that involved a different non-traditional and/or non-motorized mode (such as agricultural vehicles, ATVs, or bicycles)?

- ◯ Yes
- ◯ No
- ◯ I prefer not to answer

Snowmachines/Snowmobiles

74. Did this crash occur on public or private property?

- ◯ On public property
- ◯ On private property

75. Where did this crash occur?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

76. Which of the following occurred as a result of the crash? Select all that apply.

- [ ] No damage or injury
- [ ] Property damage only
- [ ] Personal injury/Injury to others
- [ ] Fatality
- [ ] Other (please specify)

77. In your opinion, what might have been done to prevent this crash?

78. Do you do anything to make yourself more visible when riding a snowmachine? Select all that apply.

- [ ] Wear bright colors
- [ ] Wear fluorescent or reflective clothing
- [ ] Wear other lights on self or belongings
- [ ] Use additional reflectors
- [ ] Accessorize with safety flags or similar objects
- [ ] N/A
- [ ] Other (please specify)

79. If you use these features to make yourself more visible, when do you use them?

- ( ) Day time only
- ( ) Night time only
- ( ) Both
- ( ) N/A

80. How often do you wear a helmet when riding?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

Agricultural Vehicles

The following questions are about your agricultural vehicle ownership and use.

81. How many individuals, including yourself, drive an agricultural vehicle in your household?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

82. How many of these individuals are under the age of 16?

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

83. On average, how many hours do you put on your agricultural vehicle on or near roads in year?

- ◯ Less than 50
- ◯ 50-100
- ◯ 101-200
- ◯ 201-400
- ◯ 401-600
- ◯ More than 600

84. How frequently do you drive on the following types of road components?

	Always	Often	Sometimes	Rarely	Never
On the shoulders of two lane roads (paved)	◯	◯	◯	◯	◯
On the shoulders of two lane highways (paved)	◯	◯	◯	◯	◯
On the shoulders of multilane highways (paved)	◯	◯	◯	◯	◯
Bike lanes on roads	◯	◯	◯	◯	◯
Sidewalks	◯	◯	◯	◯	◯
Bike/walking path/trail	◯	◯	◯	◯	◯

85. How did you learn to drive an agricultural vehicle? Select all that apply.

- ☐ Organized training
- ☐ Received training from friend or relative
- ☐ Self-taught
- ☐ Other (please specify)

* 86. Have you ever been in a crash with an automobile while driving an agricultural vehicle?

- ◯ Yes
- ◯ No
- ◯ I prefer not to answer

Agricultural Vehicles

87. Did your last crash with an automobile occur on public or private property?

- ◯ On public property
- ◯ On private property

88. While driving an agricultural vehicle, where did your last crash with an automobile occur?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

89. Which of the following occurred as a result of the crash with an automobile? Select all that apply.

- ☐ No damage or injury
- ☐ Property damage only
- ☐ Personal injury/Injury to others
- ☐ Fatality
- ☐ Other (please specify)

90. In your opinion, what might have been done to prevent this crash with an automobile?

91. Does driving an agricultural vehicle in mixed traffic seem to reduce your safety?

- ◯ Yes
- ◯ No
- ◯ N/A

92. What are some road characteristics you have observed that made you feel safer while driving in mixed traffic? Select all that apply.

- [ ] Signage that cautions automobile drivers that non-traditional and non-motorized vehicles (i.e. ATVs) may be present
- [ ] Pavement markings that section off an area for non-traditional and non-motorized vehicle (i.e. ATVs) use
- [ ] Wider lanes
- [ ] Wider shoulders
- [ ] Lighting
- [ ] Not applicable
- [ ] Other (please specify)

93. Have you ever been in a crash riding an agricultural vehicle that involved a different non-traditional and/or non-motorized mode (such as ATVs, bicycles, or pedestrians)?

- ◯ Yes
- ◯ No
- ◯ I prefer not to answer

Agricultural Vehicles

94. Did this crash occur on public or private property?

- ◯ On public property
- ◯ On private property

95. While driving an agricultural vehicle, where did this crash occur?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

96. Which of the following occurred as a result of the crash? Select all that apply.

- [ ] No damage or injury
- [ ] Property damage only
- [ ] Personal injury/Injury to others
- [ ] Fatality
- [ ] Other (please specify)

97. In your opinion, what might have been done to prevent this crash?

Bicycles

The following questions are about your bicycle ownership and use.

98. How many individuals, including yourself, ride a bicycle in your household?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

99. How many of these individuals are under the age of 16?

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

100. On average, how many miles do you travel by bike in a month?

- ◯ Less than 10
- ◯ 10-50
- ◯ 51-100
- ◯ 101-250
- ◯ More than 250

101. On average, how many days out of the month do you ride a bicycle?

- ◯ 1-3
- ◯ 4-6
- ◯ 7-10
- ◯ 11-15
- ◯ 16-20
- ◯ 21-31

102. I ride my bicycle for:

- ◯ Only recreational uses (e.g., exercise, trail riding, etc.)
- ◯ Mostly recreational uses
- ◯ Some recreational and some utilitarian uses
- ◯ Mostly utilitarian uses (e.g., errands, daily travel, etc.)
- ◯ Only utilitarian uses

103. What is the average length of your trip using a bicycle?

- ◯ Less than 1 mile
- ◯ 1-3 miles
- ◯ 4-6 miles
- ◯ 7-10 miles
- ◯ 11-15 miles
- ◯ 16-20 miles
- ◯ 21-30 miles
- ◯ 30+ miles

104. How did you learn to ride a bicycle? Select all that apply.

- ☐ Organized training
- ☐ Received training from friend or relative
- ☐ Self-taught
- ☐ Other (please specify)

105. Why do you most commonly ride a bicycle? Select all that apply.

- ☐ Commuting or for work
- ☐ Commuting or for school
- ☐ Recreation/Exercise
- ☐ Personal trips (i.e., errands, picking up someone, visiting others)
- ☐ Other (please specify)

106. How frequently do you ride on the following types of road components?

	Always	Often	Sometimes	Rarely	Never
On the shoulders of two lane roads (paved)	○	○	○	○	○
On the shoulders of two lane highways (paved)	○	○	○	○	○
On the shoulders of multilane highways (paved)	○	○	○	○	○
Bike lanes on roads	○	○	○	○	○
Sidewalks	○	○	○	○	○
Bike/walking path/trail	○	○	○	○	○

107. When traveling in the roadway, which way do you mostly face?

- ○ Facing traffic (i.e. against the direction of traffic)
- ○ With traffic (i.e. traveling in the same direction as traffic)

* 108. Are bike paths or shared-use paths available within a quarter mile of where you live? (Bike paths are typically separated facilities located away from a roadway.)

- ○ Yes
- ○ No

Bicycles

109. Are there any reasons why you choose not to use bike paths? Select all that apply.

- ☐ Poor surface condition
- ☐ Doesn't lead where I need to go
- ☐ Too crowded
- ☐ Doesn't feel safe
- ☐ Other (please specify)

* 110. Are bike lanes on a roadway available within a quarter mile of where you live? (Bike lanes are facilities typically located on a roadway.)

- ◯ Yes
- ◯ No

Bicycles

111. Are there any reasons why you choose not to use bike lanes if they are available? Select all that apply.

- ☐ Poor surface condition
- ☐ Don't feel comfortable with cars
- ☐ Too crowded
- ☐ I feel safer on the sidewalk
- ☐ Other (please specify)

112. If you have felt unsafe while riding your bike on or near a roadway, why? Select all that apply.

- ☐ Presence of motorists
- ☐ Uneven walkways or roadway surfaces
- ☐ Dogs or other animals
- ☐ Other bicycle or pedestrian traffic
- ☐ Lack of room
- ☐ Obstacles blocking path
- ☐ Not maintained
- ☐ Not applicable
- ☐ Other (please specify)

113. If a motorist made you feel unsafe, how did they do so? Select all that apply.

- [ ] Cut me off
- [ ] Honked at me
- [ ] Almost hit me/near miss
- [ ] Just the presence of the motorist was threatening
- [ ] Drove too fast
- [ ] Not applicable/Don't make me feel unsafe
- [ ] Other (please specify)

* 114. Have you ever been in a crash with an automobile while riding a bicycle?

- ( ) Yes
- ( ) No
- ( ) I prefer not to answer

Bicycles

115. Did this crash with an automobile occur on public or private property?

- ( ) On public property
- ( ) On private property

116. While riding a bicycle, where did this crash with an automobile occur?

- ( ) Off-road/Trail
- ( ) At or in an intersection
- ( ) Non-intersection road crossing
- ( ) Along the roadway
- ( ) Other (please specify)

117. Which of the following occurred as a result of the crash with an automobile? Select all that apply.

- [ ] No damage or injury
- [ ] Property damage only
- [ ] Personal injury/Injury to others
- [ ] Fatality
- [ ] Other (please specify)

118. In your opinion, what might have been done to prevent the crash with an automobile?

119. What are some road characteristics you have observed or place that made you feel safer while riding in mixed traffic? Select all that apply.

- [ ] Signage that cautions automobile drivers that non-traditional and non-motorized vehicles (i.e. ATVs) may be present
- [ ] Pavement markings that section off an area for non-traditional and non-motorized vehicle (i.e. ATVs) use
- [ ] Wider lanes
- [ ] Wider shoulders
- [ ] Lighting
- [ ] Not applicable
- [ ] Other (please specify)

* 120. Have you ever been in a crash riding a bicycle that involved a different non-traditional and/or non-motorized mode (such as ATVs, snowmachines, or pedestrians)?

- ○ Yes
- ○ No
- ○ I prefer not to answer

Bicycles

121. Did this crash occur on public or private property?

- ◯ On public property
- ◯ On private property

122. While riding a bicycle, where did this crash occur?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

123. Which of the following occurred as a result of the crash? Select all that apply.

- ☐ No damage or injury
- ☐ Property damage only
- ☐ Personal injury/Injury to others
- ☐ Fatality
- ☐ Other (please specify)

124. In your opinion, what might have been done to prevent the crash?

125. Do you do anything to make yourself more visible? Select all that apply.

- [ ] Use headlight
- [ ] Use taillight
- [ ] Wear fluorescent or reflective clothing
- [ ] Wear other lights on self or belongings
- [ ] Use additional reflectors
- [ ] Accessorize with safety flags (or similar objects)
- [ ] Other (please specify)

126. If you use these features to make yourself more visible, when do you use them?

- ◯ Day time only
- ◯ Night time only
- ◯ Both
- ◯ N/A

127. How often do you wear a helmet when riding?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

Pedestrians

The following questions are about walking/exercising as a pedestrian.

128. How many individuals, including yourself, walk as a means of traveling in your household?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

129. How many of these individuals are under the age of 16?

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

130. On average, how many miles do you travel by walking in a month?

- ◯ Less than 10
- ◯ 10-25
- ◯ 26-50
- ◯ 51-100
- ◯ More than 100

131. On average, how many days out of the month do you walk as a means of traveling?

- ◯ 1-3
- ◯ 4-6
- ◯ 7-10
- ◯ 11-15
- ◯ 16-20
- ◯ 21-31

132. I walk for:

- ◯ Only recreational uses (e.g., exercise, trail walking/hiking, etc.)
- ◯ Mostly recreational uses
- ◯ Some recreational and some utilitarian uses
- ◯ Mostly utilitarian uses (e.g., errands, daily travel, etc.)
- ◯ Only utilitarian uses

133. What is the average length of your walking trip?

- ◯ Less than 1 mile
- ◯ 1-3 mile
- ◯ 4-6 miles
- ◯ 7-10 miles
- ◯ 11-15 miles
- ◯ 16-20 miles
- ◯ 21-30 miles
- ◯ 30+ miles

134. Why do you most commonly walk as a means of traveling? Select all that apply.

- ☐ Commuting or for work
- ☐ Commuting or for school
- ☐ Recreation/exercise
- ☐ Personal trips (i.e., errands, picking up someone, visiting others)
- ☐ Required for my job
- ☐ Drop off/Pick up someone
- ☐ Visit a friend or relative
- ☐ Other (please specify)

135. How frequently do you travel on the following types of road components as a pedestrian?

	Always	Often	Sometimes	Rarely	Never
On the shoulders of two lane roads (paved)	○	○	○	○	○
On the shoulders of two lane highways (paved)	○	○	○	○	○
On the shoulders of multilane highways (paved)	○	○	○	○	○
Bike lanes on roads	○	○	○	○	○
Sidewalks	○	○	○	○	○
Bike/walking path/trail	○	○	○	○	○

136. Are walking path(s) available within a quarter mile of where you live?

- ○ Yes
- ○ No

137. If there are walking paths available, how often do you use them?

- ○ Always
- ○ Often
- ○ Sometimes
- ○ Rarely
- ○ Never
- ○ N/A or not available

138. Are there any reasons why you choose not to use these paths? Select all that apply.

- ☐ Poor surface condition
- ☐ Doesn't lead where I need to go
- ☐ Too crowded
- ☐ Doesn't feel safe
- ☐ Other (please specify)

* 139. Are sidewalks available within a quarter mile of where you live?

- ◯ Yes
- ◯ No

Pedestrians

140. If sidewalks are not available, where do you walk?

- ◯ In the road
- ◯ On the shoulder of the road
- ◯ Along the side of the road
- ◯ N/A
- ◯ Other (please specify)

141. When walking on the roadway, which direction do you mostly face?

- ◯ Facing traffic (i.e. against the direction of traffic)
- ◯ With traffic (i.e. traveling in the same direction as traffic)
- ◯ I don't walk on the roadway

142. What are some road characteristics you have observed or place that made you feel safer while walking in mixed traffic? Select all that apply.

- ☐ Signage that cautions automobile drivers that non-traditional and non-motorized vehicles (i.e. ATVs) may be present
- ☐ Pavement markings that section off an area for non-traditional and non-motorized vehicle (i.e. ATVs) use
- ☐ Wider lanes
- ☐ Wider shoulders
- ☐ Lighting
- ☐ Not applicable
- ☐ Other (please specify)

143. If you have felt unsafe while walking on or near a roadway, why? Select all that apply.

- [ ] Presence of motorists
- [ ] Uneven walkways or roadway surfaces
- [ ] Dogs or other animals
- [ ] Other bicycle or pedestrian traffic
- [ ] Lack of room
- [ ] Obstacles blocking path
- [ ] Not maintained
- [ ] N/A
- [ ] Other (please specify)

144. If a motorist made you feel unsafe, how did they do so? Select all that apply.

- [ ] Cut me off
- [ ] Honked at me
- [ ] Almost hit me/near miss
- [ ] Just the presence of the motorist was threatening
- [ ] Drove too fast
- [ ] Not applicable/Don't make me feel unsafe
- [ ] Other (please specify)

* 145. Have you ever been hit by an automobile while walking?

- ○ Yes
- ○ No
- ○ I prefer not to answer

Pedestrians

146. Were you hit by an automobile on public or private property?

- ◯ On public property
- ◯ On private property

147. While walking, where were you hit by an automobile?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

148. Which of the following occurred as a result of this incident? Select all that apply.

- ☐ No damage or injury
- ☐ Property damage only
- ☐ Personal injury/Injury to others
- ☐ Fatality
- ☐ Other (please specify)

149. In your opinion, what might have been done to prevent the crash with an automobile?

* 150. Have you ever been hit when walking by a non-traditional and/or non-motorized vehicle (i.e. ATV or bicycle)?

- ◯ Yes
- ◯ No

Pedestrians

151. Were you hit on public or private property?

- ◯ On public property
- ◯ On private property

152. While walking, where were you hit?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

153. Which of the following occurred as a result of this incident? Select all that apply.

- ☐ No damage or injury
- ☐ Property damage only
- ☐ Personal injury/Injury to others
- ☐ Fatality
- ☐ Other (please specify)

154. In your opinion, what might have been done to prevent this?

155. Do you do anything to make yourself more visible as a pedestrian? Select all that apply.

- ☐ Wear fluorescent or reflective clothing/shoes
- ☐ Wear other lights on self or belongings
- ☐ Travel only in well-lit areas
- ☐ N/A
- ☐ Other (please specify)

156. If you use these features to make yourself more visible as a pedestrian, when do you use them?

- ◯ Day time only
- ◯ Night time only
- ◯ Both
- ◯ N/A

Dogsled/Dog-Powered Transportation

The following questions are about dogsleds and dog-powered modes of transportation.

157. How many individuals, including yourself, use dog-powered modes of transportation in your household?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

158. How many of these individuals are under the age of 16?

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6+

159. In which of the following ways do you typically use your dog/dog team? Select all that apply.

- [ ] Transportation
- [ ] Racing-related activities (competitive, sprint, distance, clubs, etc.)
- [ ] Other recreational activities (camping, skijoring, bikejoring, etc.)
- [ ] Gathering Resources (trapping, hauling wood or water, etc.)
- [ ] Other (please specify)

160. On average, how many miles do you travel by dog sled or another dog-powered mode in a year?

- ◯ Less than 100
- ◯ 100-250
- ◯ 251-500
- ◯ 501-1,000
- ◯ More than 500

161. Which types of activities do you typically engage in with your dog/dog team? Select all that apply.

- [ ] Sledding/Mushing
- [ ] Skijoring
- [ ] Scootering
- [ ] Bikejoring
- [ ] Carting/Rig/Sulkie
- [ ] Sulkie
- [ ] Canicross
- [ ] Other (please specify)

162. I ride my dogsled/dog-powered mode for:

- ◯ Only recreational uses (e.g., hunting, trail riding, etc.)
- ◯ Mostly recreational uses
- ◯ Some recreational and some utilitarian uses
- ◯ Mostly utilitarian uses (e.g., errands, daily travel, etc.)
- ◯ Only utilitarian uses

163. In general, how did you learn to use these dog-powered modes of transportation? Select all that apply.

- [ ] Formalized Training
- [ ] Received training from friend or relative
- [ ] Self-taught
- [ ] Other (please specify)

164. How many years have you been engaged in dog-powered travel/activities?

- ◯ Less than 1
- ◯ 1-2
- ◯ 3-5
- ◯ 6+

165. On average, how many days out of the month do you use a dog-powered mode of transportation?

- ◯ 1-3
- ◯ 4-6
- ◯ 7-10
- ◯ 11-15
- ◯ 16-20
- ◯ 21-31

Dogsled/Dog-Powered Transportation

166. Are there adequate trails near where you live?

- ◯ Yes
- ◯ No

167. How do you typically access these trails?

- ◯ Using dog-powered mode directly from my home
- ◯ Haul dogs/gear by automobile to trail head
- ◯ Other (please specify)

168. On average, how far do you typically travel to access trail systems?

- ◯ 0 - 1 miles
- ◯ 2 - 5 miles
- ◯ 6 - 10 miles
- ◯ 11 - 20 miles
- ◯ 20+ miles

169. How frequently do you travel across the following types of road components with your dog/dog-team?

	Always	Often	Sometimes	Rarely	Never
On the shoulders of two lane roads (paved)	◯	◯	◯	◯	◯
On the shoulders of two lane highways (paved)	◯	◯	◯	◯	◯
On the shoulders of multilane highways (paved)	◯	◯	◯	◯	◯
Bike lanes on roads	◯	◯	◯	◯	◯
Sidewalks	◯	◯	◯	◯	◯
Bike/walking path/trail	◯	◯	◯	◯	◯

170. If traveling with your dog/dog-team in the roadway, which way do you mostly face?

- ◯ Facing traffic (i.e. against the direction of traffic)
- ◯ With traffic (i.e. traveling in the same direction as traffic)
- ◯ Not applicable

171. Why do you most commonly use a dog-powered mode of transportation? Select all that apply.

- [ ] Commuting or for work
- [ ] Commuting or for school
- [ ] Recreation/Exercise
- [ ] Personal trips (i.e., errands, picking up someone, visiting others)
- [ ] Other (please specify)

172. If you have felt unsafe while traveling with your dog/dog-team on, adjacent to, or near roadways, select all that apply.

- [ ] Motorists (while operating on or near roads)
- [ ] Road crossings on blind corners
- [ ] Road or driveway crossing that is higher than trail
- [ ] Obstacles blocking path (such as debris or berms of snow)
- [ ] Narrow trail or path
- [ ] Too much mushing traffic
- [ ] Other non-motorized user traffic (skiing, fatbiking, snowshoeing, etc.)
- [ ] Other motorized user traffic (such as snowmachines/snowmobiles)
- [ ] N/A
- [ ] Other (please specify)

173. If a motorists made you feel unsafe, select all that apply.

- [ ] Cut me off
- [ ] Drove very close to me
- [ ] Honked at me
- [ ] Almost hit me
- [ ] Drove too fast
- [ ] Just the presence of the motorist was threatening
- [ ] N/A
- [ ] Other (please specify)

* 174. Have you ever been in a crash with an automobile while using your dog/dog-team?

- ◯ Yes
- ◯ No
- ◯ I prefer not to answer

Dogsled/Dog-Powered Transportation

175. Did your last crash with this automobile occur on public or private property?

- ◯ On public property
- ◯ On private property

176. While using your dog/dog-team,where did your last crash occur?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

177. Which of the following occurred as a result of this crash with an automobile? Select all that apply.

- ☐ No damage or injury
- ☐ Property damage only
- ☐ Personal injury/Injury to others
- ☐ Fatality
- ☐ Other (please specify)

178. In your opinion, what might have been done to prevent this crash with an automobile?

Dogsled/Dog-Powered Transportation

179. Does riding with your dog/dog-team in mixed traffic seem to reduce your safety?

- ◯ Yes
- ◯ No
- ◯ N/A

180. What are some road characteristics you have observed in another town or place that made you feel safer? Select all that apply.

- ☐ Signage that cautions automobile drivers that non-traditional and non-motorized vehicles (i.e. ATVs) may be present
- ☐ Pavement markings that section off an area for non-traditional and non-motorized vehicle (i.e. ATVs) use
- ☐ Wider lanes
- ☐ Wider shoulders
- ☐ Lighting
- ☐ Not applicable
- ☐ Other (please specify)

* 181. Have you ever been in a crash while riding with your dog/dog-team that involved a different non-traditional and/or non-motorized vehicle (for example ATVs, snowmachines, skiers, pedestrians, or bicycles)?

- ◯ Yes
- ◯ No
- ◯ I prefer not to answer

Dogsled/Dog-Powered Transportation

182. Did this crash occur on public or private property?

- ◯ On public property
- ◯ On private property

183. While using your dog/dog-team, where did this crash occur?

- ◯ Off-road/Trail
- ◯ At or in an intersection
- ◯ Non-intersection road crossing
- ◯ Along the roadway
- ◯ Other (please specify)

184. Which of the following occurred as a result of the crash? Select all that apply.

- ☐ No damage or injury
- ☐ Property damage only
- ☐ Personal injury/Injury to others
- ☐ Fatality
- ☐ Other (please specify)

185. In your opinion, what might have been done to prevent this crash?

186. Do you do anything to make yourself more visible when riding with your dog/dog-team? Select all that apply.

- ☐ Wear bright colors
- ☐ Wear fluorescent or reflective clothing
- ☐ Wear other lights on self or belongings
- ☐ Ensure I have reflectors
- ☐ Accessorize with safety flags or similar objects
- ☐ N/A
- ☐ Other (please specify)

187. If you use features to make yourself more visible when riding with your dog/dog-team, when do you use them?

- ◯ Day time only
- ◯ Night time only
- ◯ Both
- ◯ N/A

188. How often do you wear a helmet when riding with your dog/dog-team?

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

Crash Reporting

The following questions are about unreported crashes that occurred on public property.

* 189. As either an ATV, snow machine/snowmobile, agricultural vehicle, or dogsled/dog-powered mode user, have you been involved in an unreported crash on public property involving an automobile in the last five years?

- ◯ Yes
- ◯ No
- ◯ Prefer not to answer
- ◯ Question does not apply to me

* 190. As either a bicyclist or pedestrian, have you been involved in an unreported crash on public property involving an automobile in the last five years?

- ◯ Yes
- ◯ No
- ◯ Prefer not to answer
- ◯ Question does not apply to me

* 191. In the last five years, have you been involved in an unreported crash on public property involving two non-automobile modes (i.e., ATV and bicycle, snow machine and dogsled, etc.)?

- ◯ Yes
- ◯ No
- ◯ Prefer not to answer
- ◯ Question does not apply to me

Crash Reporting

192. Consider your most recent unreported crash on public property. What transportation type were you using when this crash occurred?

- ◯ ATV
- ◯ Snowmachine/snowmobile
- ◯ Agricultural vehicle
- ◯ Dogsled/dog-powered mode
- ◯ Bicycle
- ◯ Pedestrian/walking
- ◯ Other (please specify)

193. Consider your most recent unreported crash on public property. Why was this crash unreported? Check all that apply.

- ☐ No property damage
- ☐ No personal injury
- ☐ Property damage only (minor)
- ☐ Personal injury (minor)
- ☐ Lack of reportable information
- ☐ Prefer not to answer

Other (please specify)

194. Did this unreported crash on public property involve any operators under the age of 16?

- ◯ Yes
- ◯ No
- ◯ Prefer not to answer

Respondent Characteristics

The questions in this section help us to ensure that we have obtained a representative sample of the population. Please be reminded that your responses are anonymous.

195. Do you have a (State Issued) Driver's License?

- ◯ Yes
- ◯ No

196. What is your employment status?

- ◯ Employed full-time
- ◯ Employed part-time
- ◯ Not currently employed

197. What description best describes your occupation?

- ◯ Salaried / Employee
- ◯ Self-Employed
- ◯ Student
- ◯ Retired
- ◯ Homemaker
- ◯ Other (please specify)

198. How would you best describe your job category?

- ◯ Sales/Service
- ◯ Clerical/Admin support
- ◯ Manufacturing, construction, maintenance, or farming
- ◯ Professional, managerial, or technical
- ◯ Other (please specify)

199. What age range describes you?

- ◯ 18-25
- ◯ 26-30
- ◯ 31-40
- ◯ 41-50
- ◯ 51-60
- ◯ Over 60

200. What is your sex?

- ◯ Male
- ◯ Female
- ◯ Other

201. What is your marital status?

- ◯ Single
- ◯ Married or with partner
- ◯ Separated, divorced, or widowed
- ◯ Other (please specify)

202. What is your highest completed education level?

- ◯ Less than high school diploma
- ◯ High school diploma or equivalency
- ◯ Some college, no degree
- ◯ Associate degree
- ◯ Bachelor's degree
- ◯ Graduate or professional degree

203. What is your approximate annual household income?

- ◯ Under $25,000
- ◯ $25,000 - $49,999
- ◯ $50,000 - $74,999
- ◯ $75,000 - $99,999
- ◯ $100,000 - $124,999
- ◯ $125,000 or more

* 204. What state do you primarily live in?

- ◯ Alaska
- ◯ Idaho
- ◯ Washington
- ◯ Oregon
- ◯ Montana
- ◯ Other (please specify)

205. What is the zip code of the community that you primarily live in?

206. Please feel free to provide any general comments or feedback about the survey or additional information here.